ATTORNEY DOCKET NO. 5923.0001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	Goecke
TITLE	:	Adhesive Tape
SERIAL NO.	:	10/674,108
FILING DATE	:	September 29, 2003
ART UNIT	:	1788
CONFIRMATION NO.	:	2438
ATTORNEY DOCKET NO.	:	5923.0001

DECLARATION OF JOSEPH T. MAUSAR UNDER 37 C.F.R. 1.132

I, Joseph T. Mausar, declare that:

1. I am Director of Marketing & Regulatory Affairs of Chemsultants International. My curriculum vitae is attached at Exhibit A.
2. I attended Kansas City Institute of Art in Kansas City, Missouri and graduated with a Bachelor of Fine Arts in Industrial Design. I also attended Baldwin-Wallace College in Cleveland, Ohio and graduated with a Masters in Business Administration.
3. Prior to my present position at Chemsultants International, I was employed at Avery Dennison from 1974 to 1987 in various positions related to pressure sensitive products used in various applications including labels, tapes and graphic materials. I have over 25 years of direct experience in pressure sensitive adhesive products.

4. I am a joint inventor on U.S. Patent Application No. 12/231,501 entitled "Multilayered, Composite Proton Exchange Membrane and a Process for Manufacturing the Same."

5. I am being compensated for preparing this declaration at my normal consulting rate.

6. I have reviewed the specification and drawings of the application as filed, and the current claims of the captioned application ("the Subject Application"). I have also reviewed the Office Action dated August 23, 2010 ("the Office Action") in the Subject Application. Copies of the Subject Application and the Office Action are attached at tabs B and C respectively.

7. In my opinion, a person having ordinary skill in the art at the time of the invention disclosed in the Subject Application is one with a background in pressure sensitive adhesive technology and products combined with 3-5 years minimum experience in the physical testing, research or quality assurance areas of pressure sensitive adhesives. I qualify as a person of ordinary skill art.

8. Regarding the rejection under 35 U.S.C. §112, first paragraph, I understand the patent examiner has determined that the term "substantially uniform" in claim 1 is not supported by the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed in 2003, has possession of the claimed invention.

9. On page 4 of the filed application, the applicant describes test samples constructed of a semi-rigid, polyvinyl chloride extruded from a 2 ½ inch diameter NRM extrusion machine under specified

conditions. The paragraph continues that a textured first surface of the extruded polymer layer was achieved.

10. On page 5 of the filed application, the applicant describes tests on the textured samples constructed. 10 replicates of each sample were measured. Results indicate thickness of the material with and without the liner, on average as being 68.4 mil and 65.4 mil respectively.

11. Page 5 further describes "caliper or thickness" determinations of the example test sample described as "textured." The thickness determination is said to have been conducted according to the PSTC-33 method.

12. One skilled in the art would understand, in 2003, the PSTC-33 method included the determination of the thickness (caliper) of the pressure sensitive tape under test wherein the sample under test is placed under a presser foot of between 5 and 16 mm in diameter. This test provides a measurement of thickness of the test surface.

13. The chart on page 7 of the filed application indicates that 10 measurements of the textured samples without liners averaged 65.4 mils with a standard deviation of 0.5 mil. The standard deviation of 0.5 mil as a percentage of the indicated thickness is a 0.76% variation. As 0.5 mil is 1 standard deviation, or 1 Sigma, 66% of all areas of the sample were within 0.5 mil in thickness. At a variation of 1.5 mils, a variation of 2.3%, this variation would equate to 3 Sigma or a 99+% of all areas of the sample were within

1.5 mils in thickness. This indicates the substantial uniformity in thickness of the samples.

14. Figure 1 of the filed application shows a cross sectional view of a tape including an apparently substantially uniform polymeric material (1). At the top of page 4 of the filed application, the polymeric material is said to be preferably but not necessarily textured and having a thickness of about 0.020 to 0.065 inches.

15. Based on the disclosures above, I conclude that the Subject Application shows to one skilled in the art that the applicant possessed the claimed "substantially uniform" but possibly textured polymer layer at the time the application was filed.

16. I have also reviewed the applied prior art: U.S. Patent No. 4,484,574 to DeRusha et al. ("DeRusha"); U.S. Patent No. 3,895,153 to Johnston et al. ("Johnston"); U.S. Patent No. 5,508,084 to Reeves et al. ("Reeves"); U.S. Patent No. 4,248,762 to Hornibrook et al. ("Hornibrook");. Copies of the DeRusha, Johnston, Reeves and Hornibrook are attached at tabs D, E, F and G respectively.

17. Regarding the rejection under 35 U.S.C. §102, DeRusha discloses a foam tape that may be used as a bandage or an athletic wrap. DeRusha, Column 1, lines 6 and 7. DeRusha teaches that the adhesive must securely attach to one side of the foam and releasably adhere to the other side of the foam. DeRusha, Column 3, lines 28 – 30. To achieve this dual adhesivity – strongly adhered on one side and releasably adhered on the other – DeRusha describes rolling a sandwich of foam, adhesive and a

release liner and storing the roll for at least 24 hours allowing the adhesive to set. Afterwards, the release liner is removed resulting in the adhesive being permanently affixed to the front side of the foam layer and releasably adhered to the back side of the foam. DeRusha, Column 4, lines 6 – 9, 19 – 22 and 29 – 31.

18. DeRusha notes that a "relatively 'hard' adhesive is required if the tape is to be reversibly self-rolled. The adhesive should have peel strength (as measured by Pressure Sensitive Tape Council adhesion test method 1 (PSTC-1)) of 250 g/cm width to 850 g/cm width at 1 mil adhesive thickness...." DeRusha, Column 3, lines 40 – 45.

19. One skilled in the art would understand the PSTC-1 test method entails adhering the test sample to a backing and peeling within one minute (known as dwell) at a 180 degree angle.

20. Claim 12 of the Subject Application recites, among other things, an adhesive tape having "a peel adhesion greater than 2.0 lb/in width."

21. The specification at page 6, first full paragraph, describes the peel adhesion test conducted on the applicant's test samples. The test describes a modified PSTC-101 method. The test method describes peeling the test sample from the substrate at a 90 degree angle after a dwell time of one hour.

22. I believe the peel adhesion claim language refers to the modified test method described in the specification on page 6.

23. I do not believe that a skilled artisan would interpret the PSTC-1 test described by DeRusha to be equivalent to the test described

by the applicant. Among the reasons are the different test methodologies including a peel angle of 180 degrees in DeRusha and a peel angle of 90 degrees in the Subject Application and a dwell of one minute in DeRusha and one hour in the Subject Application. One skilled in the art would recognize that peel angle and dwell time variations will change measured peel adhesions.

24. For this reason, I disagree with the Office's contention that DeRusha's peel adhesion range teaches the claimed range for an "adhesive tape" having a peel adhesion greater than 2.0 lb/in width.

25. Therefore, it is my opinion that DeRusha fails to disclose each and every limitation of claim 12.

26. Regarding the rejections under 35 U.S.C. §103, Johnston discloses a friction-surface sheet comprised of film of polyethylene terephthalate (reference number 11) bonded on one side to thermoplastic layer (reference number 13) and bonded on the other side to an adhesive layer (reference number 38). Johnston, Column 2, lines 4 – 11 and 44 – 54.

27. Johnston further discloses that an upper, embossed layer (reference number 18) may be bonded atop the thermoplastic layer (reference number 11). Johnston, Column 2, lines 48 – 51. Johnston continues that the upper, embossed layer (reference number 18) should have a Shore A hardness between 60 and 95.

28. Based on my review of Johnston, neither Johnston's figures nor specification discloses a polymer layer (reference number 18) with

Shore A hardness between 60 and 95 attached to the layer of adhesive (reference number 38).

29. Claim 1 of the Subject Application recites, among other things, a "polymer layer having a Shore A Hardness of between about 92 and 100 .... and a layer of adhesive attached to said polymer layer."

30. I do not believe that a person skilled in the art would read Johnston's disclosure as describing an adhesive layer attached to a polymer layer.

31. For at least the reason that Johnston does not show the layer of adhesive attached to the polymer layer, it is my opinion that Johnston fails to disclose each and every limitation of claim 1.

32. Claim 11 of the Subject Application recites, among other things, a "polymer layer" and a layer of adhesive with one side "being in direct and uninterrupted contact with the polymer layer..."

33. I do not believe that a person skilled in the art would read Johnston's disclosure as describing an adhesive layer with one side being in direct and uninterrupted contact with the polymer layer.

34. For at least the reason that Johnston does not show the layer of adhesive in direct and uninterrupted contact with the polymer layer, it is my opinion that Johnston fails to disclose each and every limitation of claim 11.

35. Regarding the rejection under 35 U.S.C. §103 starting at page 7, paragraph 9 of the Office Action, Reeves discloses a mouse pad (1) having a control surface (2). Reeves, Col. 9, lines 3 and 4. Reeves

shows the control surface (2) as including a control layer (19) and describes the control layer as preferably having a "hardness ranging from about 70 durometer to about 140 durometer, measured on the Shore 'A' durometer scale." Reeves, Figures 2 – 9 and Col. 14, lines 25 – 27.

36. One skilled in the art would understand the Shore "A" durometer scale as being one of several scales to objectively assess the hardness of materials. One would also know that the range of the Shore "A" scale is 0 – 100.

37. Durometer is one of several measures of the hardness of a material. Hardness may be defined as a material's resistance to permanent indentation. The term durometer is often used to refer to the measurement, as well as the instrument itself. Durometer is used as a measure of hardness in polymers, elastomers and rubbers.

38. There are several scales of durometer, used for materials with different properties. The two most common scales, using slightly different measurement systems, are the ASTM D2240 type A (Shore A) and type D (Shore D) scales. The A scale is generally for softer plastics, while the D scale is for harder ones. Each scale results in a value between 0 and 100, with higher values indicating a relatively harder material.

39. Durometer, like many other hardness tests, measures the depth of an indentation in the material created by a given force on a standardized indenter. This depth is dependent on the hardness of

the material, its viscoelastic properties, the shape of the indenter, and the duration of the test.

40. ASTM D2240 durometers allows for a measurement of the initial hardness, or the indentation hardness after a given period of time. The basic test requires applying the force in a consistent manner, without shock, and measuring the hardness (depth of the indentation). If a timed hardness is desired, force is applied for the required time and then read.

41. The final value of the hardness depends on the depth of the indenter after it has been applied for 15 seconds on the material. If the indenter penetrates completely through, or 2.54 mm (0.100 inch) or more into a thicker material, the durometer is 0. If it does not penetrate at all, then the durometer is 100.

42. Durometer is a dimensionless quantity, and there is no simple relationship between a material's durometer in one scale, and its durometer in any other scale, or by any other hardness test.

43. On the Shore A Hardness scale a durometer value less than 0 or a value that exceeds 100 is meaningless.

44. Reeves discloses its hardness teaching only once. Specifically, Reeves makes a single mention of a Shore "A" hardness range of about 70 to about 140 at column 14, line 26.

45. The described range exceeds the limits of the scale for more than half of the range described. In other words, only the 30 units of hardness of between 70-100 of the range are possible. The 40 units of hardness above 100, that is from 101-140 Shore A, are simply impossible.

46. I cannot discern any fair teaching of the actual hardness of the control layer from the Reeves specification, and do not believe that a person skilled in the art would be able to.

47. Regarding the rejection under 35 U.S.C. §103, starting at page 9, paragraph 10 of the Office Action, Hornibrook is said to disclose, among others, "a peel adhesion greater than 2.0 lb/in width (Column 5, lines 1-3)."

48. Hornibrook describes the test methodology used to arrive at the recited peel adhesion starting at column 4, line 63. Specifically, Hornibrook recites the test as using the standard Pressure Sensitive Tape Council (PSTC) 4.5 pound (2.04 kg.) roller. The disclosure continues that the peel adhesion was measured at "180° C." after a "24 hour wetout or 'dwell' period." Column 4, line 68 bridging to column 5, line 1.

49. By convention "180° C" would indicate that the test was conducted at the called for temperature. To the contrary and after study, one skilled in the art would recognize the Celsius identifier "C" to be a typographical error. Instead of temperature, one skilled in the art would recognize that the test was conducted at a 180 degree angle.

50. That temperature was an error is supported by the balance of the Hornibrook specification. For example, where temperatures are clearly recited, they are listed in Fahrenheit with Celsius conversions noted parenthetically. See e.g. column 4, lines 30 and 51; column 6, line 24; column 7, line 1. Additionally, the specification later calls for a test to be conducted at a 180 degree angle. See, column 6, line 31.

51. Peel adhesion changes as peel angle changes. For example, at least one technical handbook notes that test results change depending on peel test angle, when all else is held constant. See, Handbook of Pressure Sensitive Adhesive Technology, 3d Edition, Satas & Associates, 1999, Chapter 5 – Peel Adhesion, page 79.

52. Claim 12 of the Subject Application recites, among other things, an adhesive tape having "a peel adhesion greater than 2.0 lb/in width."

53. The specification at page 6, first full paragraph, describes the peel adhesion test conducted on the applicant's test samples. The test describes a modified PSTC-101 method. The modifications include at least peeling the test sample from the substrate at a 90 degree angle after a dwell time of one hour. Page 6, lines 6, 7.

54. I believe the claim peel adhesion language refers to the test as described in the specification on page 6.

55. I do not believe that a skilled artisan would interpret the results of the peel adhesion test described by Hornibrook to be equivalent to the results of the peel adhesion test described by the applicant. Among the reasons are the different test methodologies including applicant's use of a 90 degree peel angle as opposed to Hornibrook's 180 degree peel angle.

56. One skilled in the art would expect peel adhesion tested at a 180 degree angle to be different than a peel adhesion tested at a 90 degree angle.

57. For this reason, I disagree with the Office's contention that Hornibrook's peel adhesion teaches the claimed peel adhesion greater than 2.0 lb/in width.

58. Therefore, it is my opinion that Hornibrook fails to disclose each and every limitation of claim 12.

All statements made of my own knowledge are true, and all statements made on information and belief are believed to be true. I have been warned that willful, false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or of any patent issuing thereon.

Date: February 22 2011

Joseph T. Mausar

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Exhibit A

Joseph Mausar CV

Joseph T. Mausar

Position: Director of Marketing & Regulatory Affairs

Areas of Expertise:

Products: PSA labels, tapes and graphics
Printing papers including coated, uncoated, impregnated and synthetics for offset sheet and flexographic roll converting
Calendared and cast PVC films
Reflective films and optics in specialty applications
Photographic film and processing
Flexographic, offset and digital printing technology
PSA coating methods including gravure, multiple roll, knife over roll, slot die and wire rod
Fuel Cell technology including polymer membranes and PEMFC MEAs

Markets: Adhesives and Coatings
Printing and Packaging
Labels & Tapes & Converting
Medical and Pharmaceutical
Fuel Cells

Business: Federal, State and Special organizational grant proposal development
Development and implementation of strategic business, marketing and sales operation plans and budgets
New product opportunity identification, product parameter definition, product development and field introductions
New sales and market development planning and implementation
Advertising, promotion and communications planning / implementation
Quality system planning and implementation
Expert witness

Industry Experience:
Avery Dennison 1974 - 1987
Flex-O-Lite/Services & Materials, 1987 – 1990
Ritrama, 1990 – 1993
Freehold Enterprises, 1994 – 1999
Chemsultants International, 1999 – present

Academic Background:
M.B.A. in Marketing Management, Baldwin-Wallace College, Cleveland, OH
B. F. A. in Industrial Design, K.C.I.A., Kansas City, MO

Training and Certifications:
ISO 17025, ISO 9001, and ISO 13485 Standards
cGMP standards
ISO 17025, A2LA Auditors program
ASTM E4, Calibration and Verification of Force Measurement Equipment

Publications:
On the Surface: Surface energy and surface tension are key measurements for the wet-out of adhesives, inks and coatings, Adhesive and Sealant Industry magazine, October, 2010, pp. 33-36.
Manufacturing pressure sensitive adhesive products, Adhesive and Sealant Industry magazine, April, 2005, pp. 35-38.
Coating Conundrum: A pilot coating company may be the answer for the roll coating of adhesives, Adhesive and Sealant Industry magazine, September, 2004, pp. 22-26.
Testing and Evaluating the performance of pressure sensitive adhesives for TDDS patches, Transdermal magazine, accepted for publication in the May 2011 issue.

Patents:
Multilayered, Composite Proton Exchange Membrane and a Process for Manufacturing the Same, U.S. Patent Application No. 12/231,501

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Exhibit B

Subject Application

Pressure Sensitive Adhesive Tape for Floor Marking

ABSTRACT:

The pressure sensitive adhesive tape of this invention comprises a first layer of polymeric material, particularly a polyvinyl chloride, having a Shore A Hardness of between 92 and 100 and a second layer of adhesive material attached to a surface of the layer of polymeric material.

BACKGROUND:

This invention relates to an adhesive tape having superior ductility, strength, tear resistance and abrasion resistance, particularly a pressure sensitive adhesive. Polymeric pressure sensitive adhesive tapes are economical and adaptable to many different applications. One primary example is as floor marking in industrial and factory environments. However, there are several disadvantages to using such tape in industrial settings. One disadvantage is that the tape lacks sufficient strength and hardness to prevent wearing, tearing, cracking and breakage from heavy and repeated traffic, such as from forklift trucks. Similarly, as a result of poor adhesive quality, repeated traffic has a tendency to detach many commercially available tapes from the floor. Another disadvantage is that the aesthetic qualities and physical properties of the tape are diminished from scuffing, scratching, and the like. Such disadvantages plague existing polymeric pressure sensitive adhesive tapes. Because of these disadvantages that have been associated with polymeric pressure sensitive adhesive tape, wide industry acceptance has been historically difficult to achieve.

Accordingly, many opt to rely on the time consuming and exacting practice of painting.

In view of the above discussion, it is an advantage of the present invention to provide a polymeric adhesive tape that has superior ductility, strength, tear resistance and abrasion resistance. Other advantages of the present invention will be apparent from the following detailed description.

SUMMARY OF INVENTION

According to one embodiment, an adhesive tape is provided. The tape has a first layer of polymeric material having a Shore A Hardness of between 92 and 100 and a thickness of between .020" and .065", and a second layer of adhesive. Preferably, the adhesive is of a pressure sensitive type.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view illustrating the embodiment of a polymeric pressure sensitive adhesive tape.

DETAILED DESCRIPTION OF THE INVENTION

The adhesive tape of this invention usually comprises a layer of polymeric material and at least one layer of adhesive material. The pressure-sensitive adhesive tape of this invention is not limited to having only the above layers of polymeric material and layer of pressure-sensitive adhesive material. It may optionally have an additional layer, such as a laminating substrate on an outermost side of the above adhesive layer. The laminating substrate is usually

peeled off and thrown away when pressure-sensitive adhesive tape is actually used. Therefore, inexpensive materials are preferred, however, there are no particular limitations on the materials used for the laminating substrate.

Figure 1 is an example of the pressure-sensitive adhesive tape of this invention wherein a layer of polymeric material (1) is attached to the top side of a layer of pressure-sensitive adhesive material (2) and a laminating substrate (3) is attached to the bottom side of the pressure-sensitive adhesive material. Upon removal of the laminating substrate (3), the tape can be applied to a floor (4) with the application of pressure.

The pressure-sensitive adhesive tape of this invention can be produced in a variety of lengths, widths, and thickness. A variety of colors can also be used for the outer surface of the layer of polymeric material (1). For example, safety yellow can be used for aisle markings, or red can be used for quarantine and reject markings in a production facility. Coloring can be achieved by introducing a colorant in any form, including pigments and dyes into the polymeric material.

The adhesive employed in layer material (3) may be any of those heretofore employed in the art for preparing adhesive structures. By way of illustration, suitable adhesives of this general description include those disclosed in U.S. Pat. No. 5,061,559, herein incorporated by reference.

The layer of polymeric material (1) may be a durable polymer such as polyvinyl chloride, polycarbonate, or a terpolymer comprised of acrylonitrile, butadiene and styrene or the like. A clear or tinted polyvinyl chloride is a preferred material. The polymer selected must have Shore A Hardness between, for example, 92-100, and preferably between 93-97. The outer surface of the

layer of polymeric material (1) is preferably textured. The layer of polymeric material (1) may have a thickness of about, for example, .020" to .065".

Advantageously, this embodiment of the invention provides improved tear resistance, strength, and abrasion resistance by employing the sum or all of the combination of polymer selected, Shore A Hardness, textured surface, and layer thickness.

EXAMPLES

One embodiment of the invention will be described below in greater detail through the following examples.

Test samples were performed on a 4" wide sample of the pressure sensitive adhesive tape of this invention. The example tape was constructed of a semi-rigid 95A polyvinyl chloride from Artemis Industries, 2550 Gilcrest Rd, Akron Oh 44305 which was extruded from a 2&½" diameter NRM extrusion machine at 360-380 °F at an extrusion rate of 400 ft per hour to yield a .065 thick, 4" wide layer. A textured first surface of the extruded polymer layer was achieved by following the above process parameters. During extrusion a rubberized double sided carpet tape (Product # 591B) from International Tape Co., P.O. Box 240, 6 Industrial Drive, Windham, NH 03087 was applied to a second side of the extruded polymer layer. A tape from Windmill Tapes of Great Britain (www.windmilltapes.com) was used for comparison purposes. Test samples were conditioned at 73 ± 3°F and 50 ± 5% relative humidity for at least 24 hours prior to testing.

Tensile strength at yield point was determined according to ASTM D 882 testing method. A 0.5" x 8" sample was prepared and placed in the jaws of the

instrument at a separation of 4.0". The tester was started at a separation rate of 2.0 in/min. At the instance the tape yielded the force was recorded. Five replicates of each sample were conducted and the results were normalized to pounds per inch width. Results indicate higher yield point and higher absolute forces involved at yield point for the pressure sensitive adhesive tape of this invention. Particularly, the yield point in both machine and traverse direction were respectively, on average, 3,176 lb/in^2 and 3,136 lb/in^2.

Tear resistance was determined according to the ASTM D 1004 test method. The samples were die cut according to the method. The liner from the sample was removed and the sample was placed in the jaws of the tester at a separation of one inch. The tester was started at a rate of 2.0 in/min. The maximum force encountered during testing was recorded. Five replicates of each sample in both the machine and traverse direction were tested. Results indicate substantially improved tear strength in both the machine and traverse directions for the pressure sensitive adhesive tape of this invention. Particularly, the tear strength in both machine and traverse direction was respectively, on average, 22.3 lb and 22.1 lb.

Caliper or thickness was determined according to the PSTC-33 method. Caliper of the material was determined both with and without the liner. Ten replicates of each sample were measured. Results indicate substantially increased thickness of the pressure sensitive adhesive tape of this invention, partly because of the inherent characteristics of the semi-rigid surface. Particularly, the thickness of the material, with and without the liner, was respectively, on average, 68.4 mil and 65.4 mil.

Peel adhesion was tested according to a modified PSTC-101D method. The modification included dwell time. Peel adhesion is a measure of the strength of the adhesive bond between the tape and the test surface. Exactly one (1.0) inch wide samples were applied to a standard stainless steel test panel at a rate of 24 in/min with a 4.5 pound rubber covered roller according to the method. The tape was then peeled from the substrate at a 90° angle after a dwell time of one hour. The force required for removal was measured. Five replicates of each sample were tested. Results indicate substantially increased peel adhesion for the pressure sensitive adhesive tape of this invention when applied to stainless steel. Particularly, the peel adhesion of this material was, on average, 5.2 lb/in width.

Abrasion resistance was determined according to a modified ASTM D 5264 test method. The material was cut to a 2.5" x 6" size. A new 2" x 4" piece of standard A-5 receptor material (moderate abrasive) from Gavarti Associates Ltd. was affixed with double-sided tape to the four pound instrument weight (0.5 lb/in2 load). This in turn was placed over the test sample. The instrument was set for 100 strokes and operation was initiated. The instrument strikes an arc with the abrasive over the test material. Each stroke consists of one motion back and forth over the sample. When the cycles were completed the weighted abrasive was lifted and the test sample removed. At the conclusion of the test the overall quality of each sample was evaluated relatively for scratch resistance. Results indicate that the abrasion resistance of the pressure sensitive adhesive tape of this invention is improved over the comparative tape.

Results obtained were as follows:

	Average	σ (standard deviation)	N (test numbers)
Tensile at Yield at 2.0 in/min, lb/in^2			
Inventive Sample Machine Direction	3,176	152	5
Inventive Sample Traverse Direction	3,136	56	5
Comparative Sample Machine Direction	2,400	160	5
Comparative Sample Transverse Direction	1,720	120	5
Tear at 2.0 in/min, lb.			
Inventive Sample Machine Direction	22.3	1.6	5
Inventive Sample Traverse Direction	22.1	0.4	5
Comparative Sample Machine Direction	2.2	0.1	5
Comparative Sample Transverse Direction	1.6	0.1	5
Caliper, mil.			
Inventive Sample With Liner	68.4	0.5	10
Inventive Sample Without Liner	65.4	0.5	10
Comparative Sample	5.5	0.04	10
Adhesion to Stainless lb/in width			
Inventive Sample	5.2	0.5	5
Comparative Sample	1.7	0.03	5
Abrasion Resistance			
Inventive Sample	Excellent – no sign of damage		
Comparative Sample	Fair – moderate damage		

Since certain changes may be made without departing from the scope of the invention herein involved, it is intended that all matter described in the foregoing description, including the examples, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An adhesive tape comprising:

(1) a polymer layer having a Shore A Hardness of between about 92 and 100; and

(2) a layer of adhesive attached to said first polymer layer.

2. The adhesive tape of claim 1, further comprising a substrate attached to outermost side of said second layer.

3. The adhesive tape claim of claim 1, wherein said polymer layer includes a textured surface.

4. The adhesive tape of claim 1, wherein said polymer layer is comprised of a polyvinyl chloride.

5. The adhesive tape of claim 1, wherein said polymer layer includes coloring pigment.

6. The adhesive tape claim of claim 4, wherein said polyvinyl chloride comprises a clear polymer.

7. The adhesive tape claim of claim 1, wherein said pressure sensitive adhesive comprises a rubberized double-sided tape.

8. The adhesive tape claim of claim 1, wherein said first layer has a thickness of between about .020" to .065

9. The adhesive tape claim of claim 1, wherein said first layer has a Shore A Hardness of between about 93 and 97.

10. The adhesive tape of claim 1, wherein said adhesive is pressure sensitive.

FIGURE 1

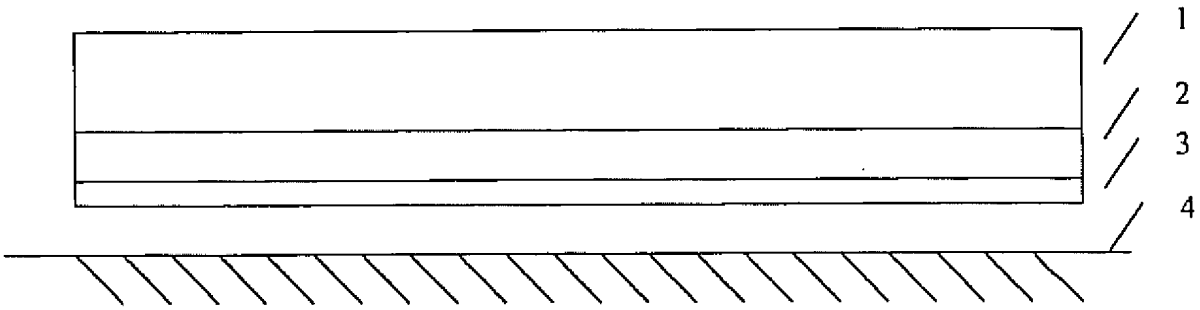

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Exhibit C

Office Action dated August 23 2010

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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10/674,108	09/29/2003	Thomas R. Goecke	5923.0001	2438

86625 7590 08/23/2010

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ART UNIT	**PAPER NUMBER**
1783	

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08/23/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@bmdllc.com
wsharders@bmdllc.com
jaruller@bmdllc.com

Office Action Summary	Application No.	Applicant(s)	
	10/674,108	GOECKE, THOMAS R.	
	Examiner	Art Unit	
	Patricia L. Nordmeyer	1783	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *15 June 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 9-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7 and 9-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____
5) ☐ Notice of Informal Patent Application
6) ☐ Other. _____

DETAILED ACTION

Reopening of Prosecution

In view of the remand filed on May 6, 2010, PROSECUTION IS HEREBY REOPENED. Upon further reconsideration of the applied prior art and arguments of record, all rejections of record as set forth in the Non-final rejection dated October 19, 2006 are hereby withdrawn. As new prior art has been found and claims furthered analyzed, new rejections have been applied below.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1 – 7, 9 and 10 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 1 contains the limitation of "substantially uniform," which is not supported by the specification. The specification is silent with regard to the thickness being uniform. However, the specification does state that the polymer layer contains a textured surface. It is unclear how the polymer layer contains both a substantially uniform thickness and a textured surface.

Claims 2 – 7, 9 and 10 are also rejected under 35 U.S.C. 112 1st paragraph due to their dependency on the above rejected claim.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1 – 7, 9 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The phrase "substantially uniform" in claim 1 is unclear, which renders the claim vague and indefinite. Claim 1 states that the thickness of the polymer layer is substantially uniform; while claim 3 states that the polymer layer has a textured surface. How can the polymer layer have a uniform thickness while having a textured surface?

Claims 2 – 7, 9 and 10 are also rejected under 35 U.S.C. 112 2nd paragraph due to their dependency on the above rejected claim.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claim 12 is rejected under 35 U.S.C. 102(b) as being anticipated by DeRusha et al. (USPN 4,484,574).

DeRusha et al. discloses an adhesive tape (Abstract) comprising: a polymer layer having a thickness between 0.031" and 0.236" (Column 2, lines 14 – 23), the polymer layer defining a first side (Figure 1, #16); and a double sided adhesive layer where one side of the double sided adhesive layer[1] is in substantially continuous contact with the first side of the polymer layer (Figure 1, #12) and an opposing side of the double sided adhesive layer is disposed to adhere to the flooring environment (Column 3, lines 28 – 52; Figure 1, #12, wherein the adhesive can attach to any substrate surface, Column 5, lines 1 - 5); where the adhesive tape has a peel adhesion of 250 g/cm to 850 g/cm width, which meets the limitation of a peel adhesion greater than 2.0 lb/in width (2.0 lb/in width converts to 357 g/cm width) (Column 3, lines 41 – 52) as in claim 12.

As to the limitation of "adhesive layer is disposed to adhere to the flooring environment", the term disposed, as defined by Merriam-Webster's, means "to give a tendency to". Since the adhesive tape of DeRusha et al. meets the claim limitations, it would be capable of, or disposed to, adhere to a flooring environment.

[1] The Examiner notes that any layer of adhesive has two sides, each side having adhesive properties. Therefore, the reference's disclosure of a layer of adhesive anticipates the claim limitation of a double sided adhesive layer.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1 – 3, 5, 7 and 9 – 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnston et al. (USPN 3,895,153).

Independent claims 1 and 11 will be addressed first.

As to claim 1, Johnston et al. discloses an adhesive article that can be formed into any shape, (Abstract; Column 8, lines 16 - 20) comprising a polymer layer having a Shore A Hardness of between about 60 and 95 (Figure 4, #18; Column 4, lines 51 – 55) and a substantially uniform thickness of 10 to 60 mils or 0.010" to 0.060" (Figure 4, #18; Column 5, lines 48 – 52); and a layer of adhesive attached to said polymer layer (Figure 6, #38).

As to claim 11, Johnston et al. also disclose an adhesive tape that can be cut into any shape including a narrow strip or band, (Abstract; Column 8, lines 16 - 20) comprising: a polymer layer having a Shore A Hardness of between about 60 and 95 (Column 4, lines 51 – 55); and a layer of pressure sensitive adhesive comprising a first side and an opposed second side (Figure 6, #38), the first side being in direct and uninterrupted contact with the polymer layer (Figure 6, #38) where the adhesive tape comprises an average thickness between 13.5 and 78 mils, since the backing sheet has a thickness of 1 to 5 mils (Column 4, lines 29 – 31) in combination with the primer layer having a thickness of 0.5 to 3 mils (Column 4, lines 45 – 47).

the copolymer layer having a thickness of 10 to 60 mils (Column 5, lines 48 – 52) and the adhesive layer having a thickness of 2 to 10 mils (Column 6, lines 11 – 13).

Johnston et al. differs from claims 1 and 11 in two ways. First, Johnston et al. fails to disclose an anticipatory example, or ranges that are sufficiently specific to anticipate the ranges of Shore A Hardness (claims 1 and 11), polymer layer thickness (claim 1) or overall tape thickness (claim 11). However, Johnson et al. teaches a range of Shore A Hardness of between about 60 and 95 (Column 4, lines 51-55) which overlaps the claim 1 and 11 range of between about 92 and 100. Johnston et al. teaches a polymer layer thickness of 0.010 to 0.060" which overlaps the claim 1 range of between about 0.020 and 0.065". Lastly, Johnston et al. teaches an overall thickness of 13.5 to 78 mils which overlaps the claim 11 range of between about 65 and 69 mils. Overlapping ranges have been held to establish *prima facie* obviousness. See MPEP 2144.05.

Therefore, it would have been obvious to one of ordinary skill in the art to have selected from the overlapping portion of the ranges of Shore A Hardness and thickness taught by Johnston et al. because overlapping ranges have been held to establish *prima facie* obviousness.

Second, Johnson et al. fail to specifically refer to its article as being an "adhesive tape." Johnston et al. teaches that the article can be formed into any shape, (Abstract; Column 8, lines 16 - 20). The term "tape," as defined by Merriam-Webster's, means "a narrow flexible strip or band." And, It is well settled that a particular shape of a prior invention carries no patentable weight unless the applicant can demonstrate that the new shape provides significant unforeseen improvements to the invention. In the instant case, the application does not indicate any new,

significant attributes of the invention due to its shape which would have been unforeseen to one of ordinary skill in the art.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to change the shape to change the shape of the adhesive article to be in the form of a narrow strip or band. One skilled in the art would have been motivated to do so in order to change the appearance of the adhesive article. MPEP 2144.04 IV.

With regard to claim 2, the article contains a substrate attached to an outermost side of said layer of adhesive (Figure 6, # 39).

For claim 3, the polymer layer includes a textured surface (Figure 4, #18).

Regarding claim 5, the polymer layer includes coloring pigment (Column 5, lines 38 – 48).

As in claim 7, the adhesive comprises a rubberized double-sided tape (Column 3, lines 43 – 49, since the adhesive has adhesive qualities on the opposite sides of the layer, it reads upon a double side adhesive product).

With regard to claim 9, polymer layer has a Shore A Hardness of between about 60 and 95, thereby meeting the limitation of a Shore A Hardness of 93 and 97 (Column 4, lines 51 – 55).

For claim 10, the adhesive is pressure sensitive (Column 5, lines 67 – 69).

9. Claims 1 – 6, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reeves et al. (USPN 5,508,084).

Reeves et al. discloses a repositionable article that can be cut into any shape, (Column 7, lines 34 – 36) comprising a polymer layer (Figure 2d, #19; Column 10, lines 21 – 29) having a

Shore A Hardness of between about 70 and 140 (Column 14, lines 25 – 29) and a substantially uniform thickness of between about 0.020" to 0.065" (Column 10, lines 30 – 35) and a layer of adhesive attached to said polymer layer (Figure 2d, #13; Column 12, lines 30 – 44).

Reeves et al. differs from claim 1 in two ways. First, Reeves et al. fails to disclose an anticipatory example, or ranges that are sufficiently specific to anticipate the claim 1 range of Shore A Hardness. However, Johnson et al. teaches a range of Shore A Hardness of between about 70 and 140 (Column 14, lines 25 – 29) which overlaps the claim 1 range. Overlapping ranges have been held to establish *prima facie* obviousness. See MPEP 2144.05.

Therefore, it would have been obvious to one of ordinary skill in the art to have selected from the overlapping portion of the ranges of Shore A Hardness taught by Reeves et al. because overlapping ranges have been held to establish *prima facie* obviousness.

Second, Reeves et al. fails to specifically refer to its article as being an "adhesive tape." Reeves et al. teaches that the article can be formed into any shape, (Column 7, lines 34 – 36). The term "tape," as defined by Merriam-Webster's, means "a narrow flexible strip or band." It is well settled that a particular shape of a prior invention carries no patentable weight unless the applicant can demonstrate that the new shape provides significant unforeseen improvements to the invention. In the instant case, the application does not indicate any new, significant attributes of the invention due to its shape which would have been unforeseen to one of ordinary skill in the art.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to change the shape to change the shape of the adhesive article to be in the form of a

narrow strip or band. One skilled in the art would have been motivated to do so in order to change the appearance of the adhesive article. MPEP 2144.04 IV.

With regard to claim 2, the article contains a substrate attached to an outermost side of said layer of adhesive (Column 13, lines 10 – 15).

For claim 3, the polymer layer includes a textured surface (Figure 2d; Column 12, lines 16 - 23).

With regard to claim 4, the polymer layer is comprised of a polyvinyl chloride (Column 13, lines 28 – 36).

Regarding claim 5, the polymer layer includes coloring pigment (Column 12, lines 25 – 31).

As in claim 6, the polyvinyl chloride comprises a clear polymer (Column 12, lines 25 – 31).

With regard to claim 9, polymer layer has a Shore A Hardness of between about 70 and 140, which overlaps the limitation of a Shore A Hardness of 93 and 97 (Column 14, lines 25 – 29).

For claim 10, the adhesive is pressure sensitive (Column 8, lines 9 – 13). However, Reeves et al. fail to disclose that the adhesive article is specifically an adhesive tape.

10. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hornibrook et al. (USPN 4,248,762).

Hornibrook et al. disclose a pressure sensitive product (Column 1, lines 10 – 13) comprising: a polymer layer having a thickness between 0.002" and 0.020", thereby overlapping

the thickness limitation of 0.020" and 0.065" (Column 2, lines 1 – 15), the polymer layer defining a first side (Figure 1, #1); and a double sided adhesive layer where one side of the double sided adhesive layer is in substantially continuous contact with the first side of the polymer layer (Column 2, lines 16 – 39; Figure 2, #2) and an opposing side of the double sided adhesive layer is disposed to adhere to the flooring environment (Column 2, lines 16 – 39; Figure 2, #2); where the adhesive tape has a peel adhesion of 7.5 pounds per linear inch, which meets the limitations of a peel adhesion greater than 2.0 lb/in width (Column 5, lines 1 – 3) as in claim 12.

Hornibrook et al. differs from claim 12 in two ways. First, Hornibrook et al. fails to disclose an anticipatory example, or ranges that are sufficiently specific to anticipate the claim 12 range of thickness of 0.020 to 0.065". However, Hornibrook et al. teaches a range of thickness of 0.002" and 0.020" (Column 2, lines 1 – 15), which overlaps the claim 12 range of between 0.020 and 0.065". Overlapping ranges have been held to establish *prima facie* obviousness. See MPEP 2144.05.

Therefore, it would have been obvious to one of ordinary skill in the art to have selected from the overlapping portion of the ranges of Shore A Hardness taught by Reeves et al. because overlapping ranges have been held to establish *prima facie* obviousness.

Second, Hornibrook et al. fail to disclose that the adhesive article is specifically an adhesive tape.

The term tape, as defined by Merriam-Webster's, means "a narrow flexible strip or band". It is well settled that a particular shape of a prior invention carries no patentable weight unless the applicant can demonstrate that the new shape provides significant unforeseen

improvements to the invention. In the instant case, the application does not indicate any new, significant attributes of the invention due to its shape which would have been unforeseen to one of ordinary skill in the art.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to change the shape of the adhesive article to be in the form of a narrow strip or band. One skilled in the art would have been motivated to do so in order to change the appearance of the adhesive article. MPEP 2144.04 IV.

As to the limitation of "adhesive layer is disposed to adhere to the flooring environment", the term disposed, as defined by Merriam-Webster's, means "to give a tendency to". Since the adhesive product of Hornibrook et al. meets the claim limitations, it would be capable of, or disposed to, adhere to a flooring environment.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia L. Nordmeyer whose telephone number is (571)272-1496. The examiner can normally be reached on Mon.-Fri. from 10:00-6:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David R. Sample can be reached on (571) 272-1376. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Patricia L. Nordmeyer
Primary Examiner
Art Unit 1783

/Patricia L. Nordmeyer/
Primary Examiner, Art Unit 1783

/David R. Sample/
Supervisory Patent Examiner, Art Unit 1783

/Sharon A. Gibson/
Director, Technology Center 1700

Notice of References Cited	Application/Control No. 10/674,108	Applicant(s)/Patent Under Reexamination GOECKE, THOMAS R.	
	Examiner Patricia L. Nordmeyer	Art Unit 1783	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-3,695,153	07-1975	Johnston et al.	428/141
*	B	US-4,248,762	02-1981	Hornibrook et al.	524/441
*	C	US-4,484,574	11-1984	DeRusha et al.	602/75
*	D	US-5,508,084	04-1996	Reeves et al.	428/172
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Merriam-Webster's Collegiate Dictionary, 1996, Merriam-Webster, Incorporated, Tenth Edition, pages 335 and 1205.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

ATTORNEY DOCKET NO. 5923.0001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	Goecke
TITLE	:	Adhesive Tape
SERIAL NO.	:	10/674,108
FILING DATE	:	September 29, 2003
ART UNIT	:	1788
CONFIRMATION NO.	:	2438
ATTORNEY DOCKET NO.	:	5923.0001

Exhibit D

DeRusha U.S. Patent 4,484,574

United States Patent [19]

DeRusha et al.

[11] **Patent Number: 4,484,574**

[45] **Date of Patent: Nov. 27, 1984**

[54] **SELF-ROLLED FOAM TAPE WITHOUT RELEASE LAYER AND METHOD OF MAKING SAME**

[75] Inventors: **Mark A. DeRusha**, El Toro; **Thomas E. Schultz**, Laguna Niguel; **Stephen W. Luchio**, Riverside, all of Calif.

[73] Assignee: **Keene Corporation**, New York, N.Y.

[21] Appl. No.: **573,854**

[22] Filed: **Jan. 25, 1984**

[51] **Int. Cl.**[3] **A61L 15/00**; B32B 1/08; B32B 7/06; B32B 7/12

[52] **U.S. Cl.** **128/156**; 128/169; 128/170; 156/230; 156/238; 156/272.6; 156/324; 428/40; 428/214; 428/215; 428/314.4; 428/317.3; 428/343; 428/355; 428/906

[58] **Field of Search** 428/40, 41, 42, 314.4, 428/314.8, 317.3, 317.7, 352, 355, 906, 213, 214, 215, 343; 128/156, 169, 170; 156/230, 238, 272.6, 324

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,458,166	1/1949	Homeyer, Jr.	428/352
2,740,402	4/1956	Scholl	128/156
3,066,043	11/1962	Hechtman et al.	428/343
3,649,436	3/1972	Buese	428/317.3
4,021,001	5/1977	Sproat	428/317.7
4,163,822	8/1979	Walter	428/355
4,251,584	2/1981	van Engelen et al.	428/343
4,341,209	7/1982	Schaar	128/156
4,404,246	9/1983	Charbonneau et al.	428/317.3

FOREIGN PATENT DOCUMENTS

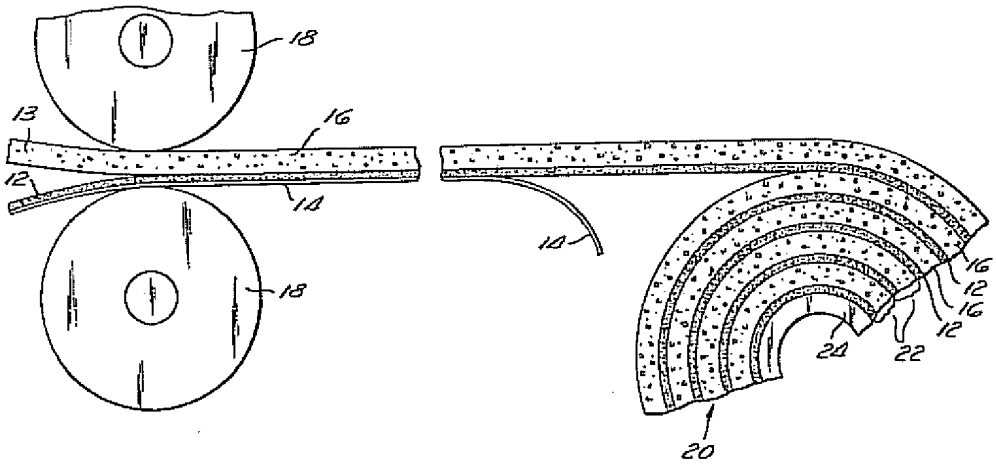
747341	11/1966	Canada	428/40
1232358	6/1969	United Kingdom	428/906

Primary Examiner—William J. Van Balen
Attorney, Agent, or Firm—Knobbe, Martens, Olson & Bear

[57] **ABSTRACT**

A pressure-sensitive tape having a closed-cell polymer foam backing strip and a pressure-sensitive adhesive is disclosed. The tape is formed into a roll so that the adhesive of one layer is in direct physical contact with the foam of the next layer, without the use of release paper or release coatings. The tape may be unwound without significantly disrupting either the adhesive layer or the foam layer. The foam is preferably a closed-cell cross-linked polyethylene copolymer and the adhesive is preferably a hypoallergenic acrylic-based adhesive.

18 Claims, 2 Drawing Figures



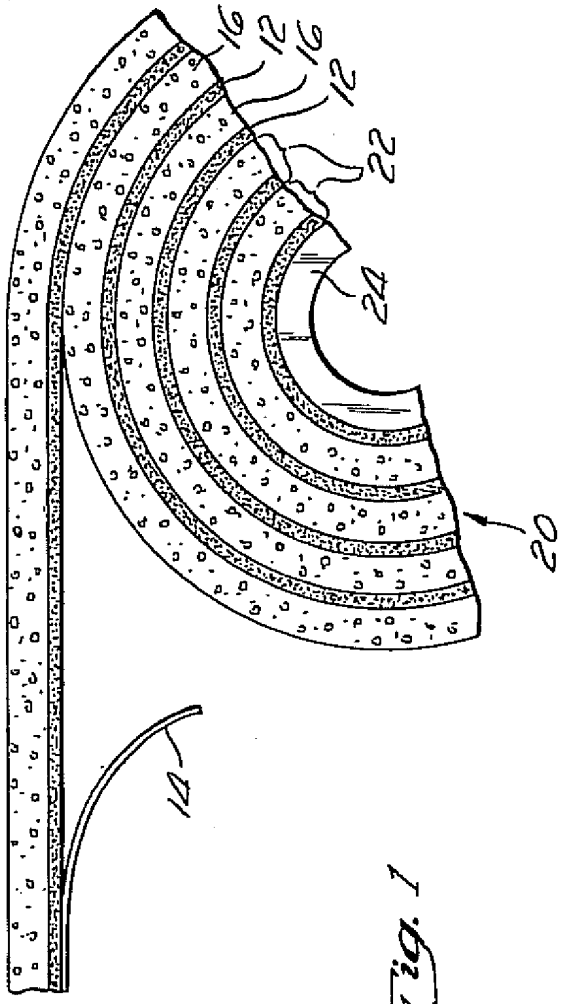


Fig. 1

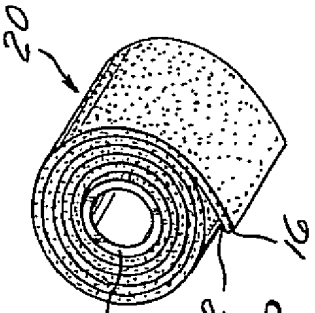
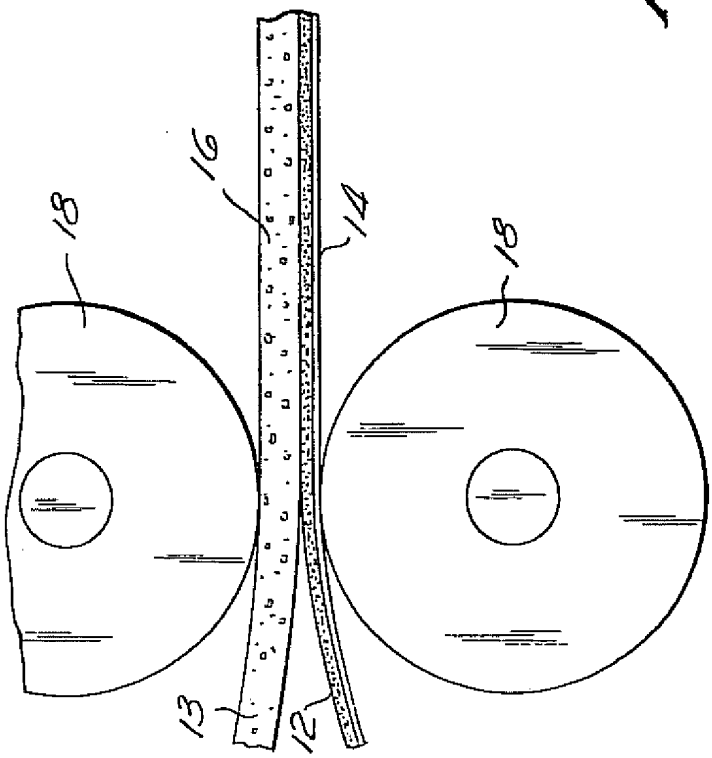


Fig. 2



SELF-ROLLED FOAM TAPE WITHOUT RELEASE LAYER AND METHOD OF MAKING SAME

BACKGROUND OF THE INVENTION

This invention relates to a foam tape which may be used, e.g., as a bandage hold down or an athletic wrap. In particular, the invention relates to a foam tape having a pressure-sensitive adhesive on one side, which can be formed into a roll and unrolled without disrupting the non-adhesive side of the tape or the adhesive and without the use of release paper or a release coating.

The use of adhesive tape in the treatment and prevention of sports injuries is well known. In general, the tape used is a cloth-backed tape, having a pressure-sensitive adhesive on one side thereof. The tape is generally porous and is supplied in roll form. This cloth-backed tape is particularly valuable for wrapping joints to prevent their movement. The tape has no appreciable stretch and, when wrapped several layers deep, it forms a hard, unyielding armour about the wrapped part.

However, conventional cloth-backed adhesive tape is not desirable for applications where limited movement of a joint is desired. Such tape can actually cut the skin when used for such applications, because of the unyielding nature of the material.

The use of stretchable foam material as a wrap for a limb is illustrated in U.S. Pat. No. 2,740,402 to W. M. Scholl. This patent discloses a bandage made of porous latex foam which may be coated with a pressure-sensitive adhesive. However, such a bandage would be unlikely to fine wide-spread use in modern day training rooms, because it cannot be self-rolled. The patent recognizes that if the bandage is wrapped upon itself, the adhesive surface and possibly the non-adhesive surface would be disrupted in an attempt to unwrap the bandage. Accordingly, a release paper applied to the adhesive side of the bandage would be necessary in order to roll the tape for shipping. Release paper, however, would be a nuisance in the training room, and the bandage could not be applied directly from the roll to an object to be wrapped without removing the release paper.

An alternative to release paper is a release coating on the back side of the tape itself. Such coatings are illustrated in U.S. Pat. No. 2,458,166 to Homeyer, Jr., and U.S. Pat. No. 3,066,043 to Hechtman et al. The use of a release coating, however, is undesirable, both because of the added expense associated with applying the release layer to the tape in the manufacturing process and because there would be inadequate adhesion between successive layers of release-coated tape when used as an athletic wrap.

Schaar, in U.S. Pat. No. 4,341,209 discloses a backing sheet made of polyethylene foam for pressure-sensitive adhesive finger bandages. Finger bandages are, typically, supplied with a release paper covering the adhesive side of the bandage.

Furthermore, the use of closed-cell polymer foam adhesive strips for weather stripping and insulating is well known. However, to the Applicants' knowledge, none of the foregoing are capable of being self-rolled without the use of release paper.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a pressure-sensitive adhesive tape, comprising a web of closed-cell polymer foam material having a front side and a back side, the web being wound into a multilayered roll so that the front side is adjacent to the back side in successive windings. A layer of pressure-sensitive adhesive is located between and in direct contact with the adjacent front and back sides of the foam in the roll. The adhesive is releasable attached to the back side and permanently attached to the front side of the foam. Thus, upon unwinding, the pressure-sensitive adhesive coated front side of the tape separates relatively easily from the back side of the tape without disrupting either the adhesive layer or the back side of the foam, with which the adhesive on the front side of the foam was in direct physical contact.

In a preferred embodiment, the tape is a copolymer polyethylene foam having a hypoallergenic acrylic-based adhesive on one side. The thickness of the foam is between about 0.8 mm and about 6 mm, preferably between about 1 mm and about 3 mm, and most preferably about 1.6 mm (1/16 inches). The tape may be from about 12 mm to about 200 mm wide, preferably from about 20 mm to about 130 mm wide, and most preferably between about 24 mm and about 60 mm wide.

The present invention provides a lightweight self-frolled tape that provides support without restraint. It is particularly suitable for athletic applications where some flexibility of the wrapped member is desired. Unlike conventional adhesive tape, the present tape (which is capable of significant elongation) bends easily around complex or compound curves and does not cut the underlying flesh in use. The insulating properties of the tape permit retention of natural body heat.

The cellular structure of the tape also provides shock absorption properties. Injured members are prevented from touching other objects. The tape absorbs both sharp and dull impact, and rebounds for continuous absorption. The tape is waterproof and, because of its reversible self-winding nature, may be unwrapped (rather than cut) for removal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of the process of manufacturing the foam tape.

FIG. 2 is a perspective view of a roll of tape according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The two basic components of the tape of the present invention are the closed-cell polymer foam backing layer and the adhesive layer. The characteristics of the foam and the adhesive must be carefully matched, in order to provide a tape that may be self-rolled without significant damage to the foam or the adhesive layer upon unrolling.

The foam may be closed-cell polymer foam material having suitable characteristics, such as homopolymers and copolymers of polyethylene, polyurethane, or any of the vinyl-based polymers. The foam must be flexible and must be capable of being formed into sheets of 6 mm thickness or less having a tensile strength (in a foam of 2 mm thickness) of at least 100 g/cm width of tape. Elasticity is also an important property. The foam tape in the desired thickness must be capable of at least 50% elongation, and preferably at least 250%.

Foams containing migratory substances are generally unsuitable. Such substances tend to affect the properties of the adhesive. In addition, they reduce the shelf-life of

the product and may not be suitable for prolonged contact with the skin. It is also desirable that the foam have an internal cellular structure and that the top and bottom surfaces of the foam exhibit continuous closed cell membranes. The membranes inhibit dirt or other substances from becoming ingrained into the foam and are also important in insuring that the self-rolled foam tape may be unrolled without significant disruption of the foam or the adhesive.

One preferred foam material is polyethylene homopolymer or copolymer. A suitable smooth-surfaced polyethylene copolymer foam sheet product is marketed by Voltek, Inc. under the trademark "VOLARA." VOLARA Type E foam is particularly preferred. Type E VOLARA is closed-cell foamed polyethylene-vinyl acetate copolymer that has been irradiation cross-linked. Its closed-cell structure is often called "fine celled". In a 1.6 mm thickness, it has a tensile strength of 620 g/cm width in tape form and may be elongated 250%. VOLARA is hypoallergenic and does not contain migratory plasticizers. Another suitable foam is a cross-linked polyethylene marketed by the Frelen Corporation under the trademark FRELEN XLPE. Closed-cell, foams, such as those marketed by 3-M Corporation, Compo Industries, E.A.R. Corporation, and Monosol, are also suitable, as are Uniroyal's polyvinylchloride-nitrile rubber foams.

The adhesive must be capable of adhering securely to one side of the foam and yet, when cured, must releasably adhere to the other side of the foam. This property permits the tape according to the invention to be self-rolled without the use of release paper or release coatings so that the tape may be self-rolled. Certain acrylic, rubber, urethane, and silicone based adhesives are suitable. A suitable adhesive will have an adhesive shear strengh of, for example, 1 kg/6.25 cm^2 for 167 hours. The viscosity of the adhesive prior to application to the foam will be 500–20,000 centipoises. An even more important determinant of suitability is the cohesive strength of the adhesive. A relatively "hard" adhesive is required if the tape is to be reversibly self-rolled. The adhesive should have a peel strength (as measured by Pressure Sensitive Tape Council adhesion test method 1 (PSTC-1) of 250 g/cm width to 850 g/cm width at 1 mil adhesive thickness, and preferably about 550 g/cm. Crosslinked acrylic adhesives are particularly preferred. It is highly desirable that the adhesive be hypoallergenic. One suitable acrylic-based adhesive is National Adhesives DURO-TAK TM 80-1054. Another is Monsanto 737. Still another is Ashland's ARO-SET TM 1910. The adhesive is preferably dispersed in an aqueous or hydrocarbon vehicle.

FIG. 1 illustrates in part the preferred process for making the foam tape according to the present invention. A layer of suitable adhesive **12** is spread on a release paper **14** by any suitable apparatus, such as a knife over a roll, a knife over a fixed rod or bed, or a Meyer rod. Any suitable release paper may be used, although a doublesided silicone-treated release paper such as H. P. Smith 8054 POLYSLIK TM is preferred. The vehicle is then flashed off by the application of heat to leave a uniform layer of adhesive **12** on the release paper **14**. This is preferably done in a zoned air-circulating oven having a final temperature of between about 95° C. and about 135° C., and preferably about 120° C. The adhesive layer is between 0.5 and 2.2 mils thick, and is preferably about 1 mil thick. The adhesive-coated side of release paper **14** is then mated with the front side **13** of a sheet of foam **16** between the pinch rollers **18** at ambient temperature. Optionally, the foam has been previously treated by a conventional corona discharge process (≦46 dyne) to enhance adhesive bonding. A three-layer sandwich of foam **16**, adhesive **12**, and release paper **14** results. In a preferred embodiment the foam, adhesive, and release paper sandwich is self-rolled and stored for a period of time sufficient to allow the adhesive to set, generally for a minimum of 24 hours. The foam, adhesive and release paper are then unrolled.

As is shown in FIG. 1, the release paper is removed, leaving the adhesive layer **12** permanently affixed to the foam **16**. The resulting pressure-sensitive foam tape is then slit to the desired width and self-rolled (without tension) into a multi-layered roll **20** having a plurality of layers **22**. Each layer **22** comprises a layer of foam **16** and a layer of adhesive **12**. Except for the innermost layer, each layer of adhesive **12** is disposed between two layers of foam **16**. In the roll, adhesive **12** is permanently affixed to the front side **13** of the adjacent covering layer of foam and is releasably adhered to the back side **24** of the supporting layer of foam.

The completed product is illustrated in FIG. 2, which is a roll **20** of pressure-sensitive adhesive tape having a foam layer **16** and an adhesive layer **12**, in which the adhesive side of each layer is in direct physical contact with the foam material of the underlying layer. The roll is formed around a cylindrical core **24**. Because no release coatings or backing papers are used, the adhesive side of each layer is releasably attached directly to the form of the underlying tape.

The tape of the present invention may be used in several ways in industrial, veterinary, athletic, and medical applications. For example, the tape may be used as a protective padding over sterile dressings. It is useful as a wrap about the limb of a mammal to prevent and treat injuries. It may be used to pad fingers, foreheads, bruises, and tendons. It may also be used to pad splints and casts externally, to minimize the effect of jolts and shocks, and may even be used in certain circumstances as a soft cast for a broken bone. Because the tape can be reversably self-rolled, multiple wrappings of tape may be removed without cutting the tape.

The tape may also be applied to any surface to provide padding. Grips, handles, and sharp surfaces may advantageously be covered. It also has utility as a metal-to-metal gasket.

EXAMPLE 1

A sheet of VOLARA type E polyethylene copolymer foam approximately 140 cm wide and 1.6 mm thick is conventionally treated with a 50 dyne corona discharge. A layer of Ashland's AROSET 1910 adhesive is applied with a knife to a sheet of double-sided silicone treated release paper. The release paper and adhesive then pass through a zoned, heated, air-circulating oven to remove the hydrocarbon vehicle from the adhesive. The final oven temperature is 120° C. The adhesive-coated side of the release paper is next mated with the corona-treated side of the foam. The foam-adhesive-release paper sandwich is then self-rolled. After 24 hours the release paper is removed and the tape is cut into 50 mm wide strips and self-wound on a polyethylene core. The resulting tape is disposed on the roll so that the adhesive side of one layer of tape is in direct physical contact with the foam backing of the adjacent layer. The foam tape may be unwound without significant disruption of either the adhesive layer or the foam

layer. No significant amount of adhesive remains on the foam side of the tape. The resulting tape is strong, light, shock-absorbant and adheres strongly but releasably to virtually any clean, dry surface including glass, metal, fabric, plaster casts, and human skin.

EXAMPLE 2

A strip of tape 50 mm wide, prepared according to Example 1, is wrapped around the limb of a mammal and over an ankle joint in multiple overlapping layers. The resulting wrap permits some movement of the ankle while providing support. The wrapping also cushions the wrapped portion against blows and significantly reduces the possibility of bruising and cartilage, tendon, and ligament injury.

Although this invention has been described in terms of certain preferred embodiments, other embodiments that are apparent to those of ordinary skill in the art are also within the scope of this invention. Accordingly, the scope of the invention is intended to be limited only by the appended claims.

What is claimed is:

1. A pressure-sensitive adhesive tape, comprising:
- a web of closed-cell polymer foam material having a front side and a back side;
- said web being wound into a multi-layered roll so that said front side is adjacent to said back side in successive windings;
- a layer of pressure-sensitive adhesive disposed between and in direct contact with said adjacent front and back sides of said foam;
- said adhesive being releasably attached to said back side and permanently attached to said front side.

2. The tape of claim 1, wherein said adhesive is hypoallergenic.

3. The tape of claim 2, wherein said adhesive is an acrylic adhesive.

4. The tape of claim 2, wherein said polymer is polythylene.

5. The tape of claim 4, wherein said foam is a polyethylene copolymer and said front and said back sides are substantially smooth.

6. The tape of claim 4, having a thickness of between about 0.8 mm and about 6 mm and a width of between about 12 mm and about 200 mm.

7. The tape of claim 6, wherein said adhesive is between about 0.5 and about 2.2 mils thick and has a PSTC-1 peel strength between about 250 g/cm width and about 850 g/cm width at 1 mil adhesive thickness.

8. The tape of claim 6, wherein said adhesive has a PSTC-1 peel strength of about 550 g/cm width at 1 mil adhesive thickness.

9. The tape of claim 4, having a thickness of between about 1 mm and about 3 mm and a width of between about 20 mm and 200 mm.

10. An article of manufacture, comprising
- a web of closed-cell polyethylene foam material having a front side and a back side;
- a layer of pressure-sensitive adhesive permanently affixed to said front side;
- said adhesive layer being releasably attachable to said back side of said foam to permit the front side of one part of said web to be adhesively attached to the back side of another part of said web and then separated without substantially disrupting said back side.

11. The article of claim 10, wherein said adhesive is hypoallergenic.

12. The article of claim 10, wherein said adhesive is between about 0.5 and about 2.2 mils thick and has a PSTC-1 peel strength between about 250 g/cm width and about 850 g/cm width at 1 mil adhesive thickness.

13. The article of claim 12, wherein said adhesive has a PSTC-1 peel strength of about 550 g/cm width at 1 mil adhesive thickness.

14. The article of claim 11, wherein said polymer is polyethylene.

15. The article of claim 11, wherein said adhesive is an acrylic adhesive.

16. The article of claim 10, wherein said article is formed into a roll having successive layers and the adhesive of one layer is directly and releasably adhered to the foam of another layer.

17. The article of claim 11, wherein said article is a bandage applied to a limb of a mammal in overlapping layers, the adhesive of one layer being in direct physical contact with the foam of an adjacent layer.

18. A process for making a self-rolled pressure-sensitive adhesive foam tape, comprising the steps of:
- subjecting a closed-cell polymer foam web to corona discharge;
- applying a layer of pressure-sensitive adhesive to a release paper;
- mating the foam web to the adhesive;
- forming the foam web, the adhesive, and the release paper into a multi-layered roll;
- unrolling the web, the adhesive, and the release paper;
- removing the release paper, leaving a pressure-sensitive adhesive tape having a foam backing side and an adhesive side; and
- self-rolling the pressure-sensitive adhesive tape into a multi-layered roll so that the adhesive side of one layer is in direct physical contact with the foam side of an adjoining layer.

* * * * *

ATTORNEY DOCKET NO. 5923.0001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	Goecke
TITLE	:	Adhesive Tape
SERIAL NO.	:	10/674,108
FILING DATE	:	September 29, 2003
ART UNIT	:	1788
CONFIRMATION NO.	:	2438
ATTORNEY DOCKET NO.	:	5923.0001

Exhibit E

Johnston U.S. Patent 3,985,153

United States Patent [19]

Johnston et al.

[11] **3,895,153**

[45] **July 15, 1975**

[54] **FRICTION-SURFACE SHEET**

[75] Inventors: **Manley R. Johnston**, St. Paul; **Roger P. Goeppinger**, N. St. Paul, both of Minn.

[73] Assignee: **Minnesota Mining and Manufacturing Company**, St. Paul, Minn.

[22] Filed: **Oct. 5, 1973**

[21] Appl. No.: **403,827**

[52] **U.S. Cl.** **428/141**; 156/209; 156/220; 264/284; 428/493; 428/494

[51] **Int. Cl.** **B32b 3/26**

[58] **Field of Search** ..... 161/116, 231, 252, 253, 161/256, DIG. 3, 255; 117/8, 10; 264/284; 156/209, 220

[56] **References Cited**

UNITED STATES PATENTS

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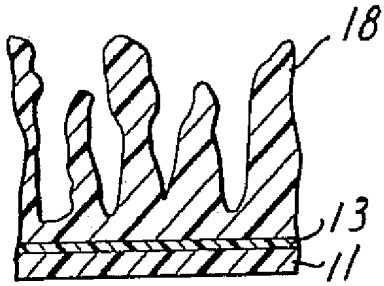
Assistant Examiner—Stanley S. Silverman
Attorney, Agent, or Firm—Alexander, Sell, Steldt and DeLaHunt

[57] **ABSTRACT**

A flat, backing layer of uniform thickness of biaxially oriented, heat set polyethylene terephthalate having adherently bonded to its upper surface a textured, tough, scuff-resistant, weather-resistant layer of certain thermoplastic ethylenic copolymers, and a normally tacky pressure-sensitive adhesive layer adherently bonded to its lower surface, provides a friction-surface sheet for use on stairs, in bath tubs and showers, and on other surfaces which may be inherently undesirably slippery. The friction-surface sheet is made by coating a thin, ultra-violet light transmissive self-sustaining layer of a coherent film forming thermoplastic polymer onto the polyethylene terephthalate layer, irradiating the interface between the layers to cause adherent bonding, coating the ethylenic copolymer on top of the polymer layer by melt fusion, and embossing the copolymer layer to provide the textured surface. Pressure-sensitive adhesive is then applied to the lower surface of the sheet to facilitate mounting thereof on any of a variety of substrates.

6 Claims, 6 Drawing Figures



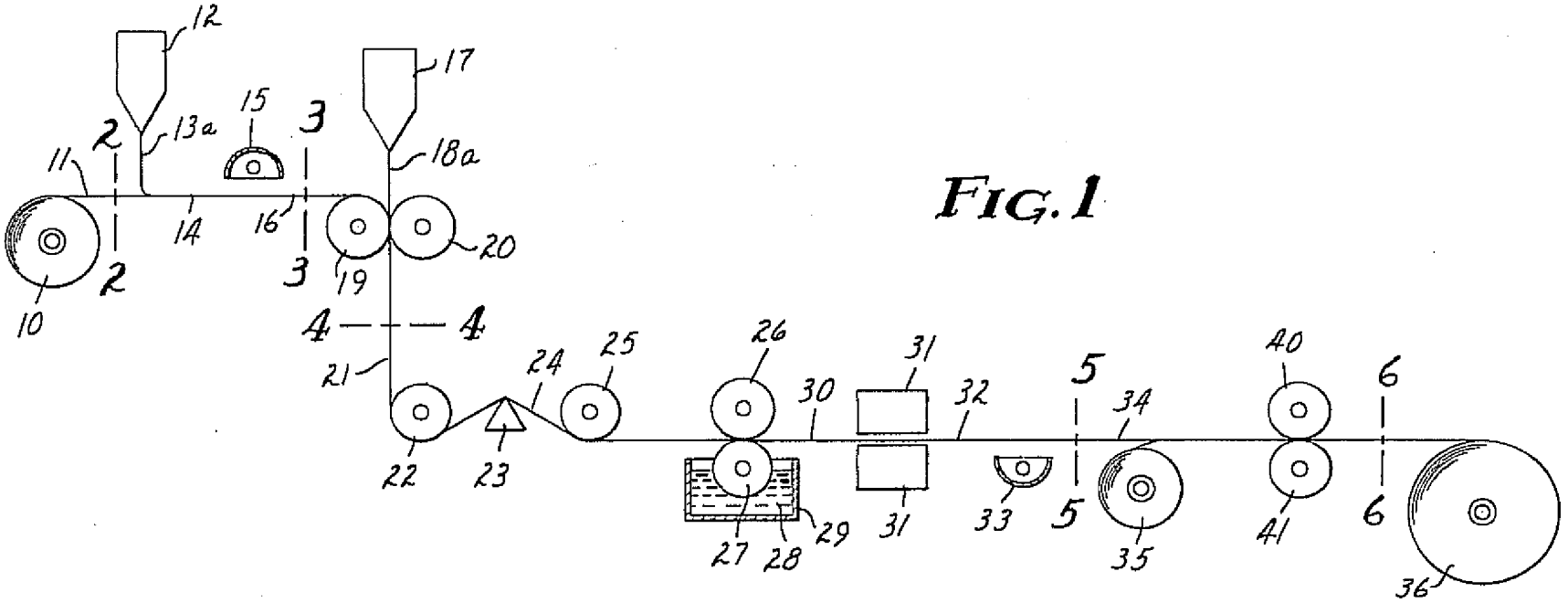


FIG. 1

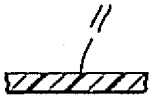


FIG. 2

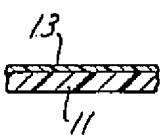


FIG. 3

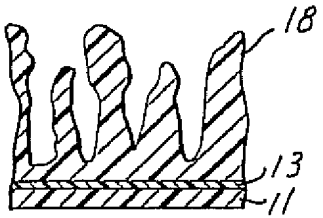


FIG. 4

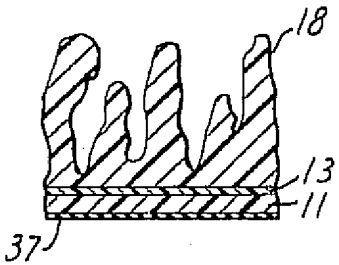


FIG. 5

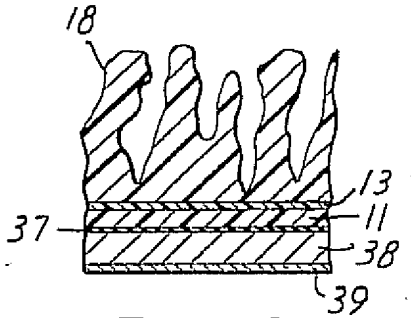


FIG. 6

FRICTION-SURFACE SHEET

BACKGROUND OF THE INVENTION

This invention relates to friction-surface sheet material.

Typically, present friction-surface or non-skid sheet materials are made by adhering granules to resin-impregnated fabric backing or plastic film by means of adhesive which is usually pigmented and overcoats the granules to provide a pleasing surface, both esthetically and underfoot. Examples of such products may be seen in U.S. Pat. Nos. Re.25,788, 3,030,251, 3,578,550, 3,030,223 and British Pat. No. 971,741. While such products have seen considerable commercial success, they have certain inadequacies which the present invention eliminates.

Since these prior art sheet materials are all formed by depositing granules on a backing sheet and overcoating the granules with adhesive, the resultant product is inherently subject to the formation of air pockets among the adhesive covered granules. Such air pockets will rupture, providing sites for bacteria to accumulate and flourish, staining the sheet and creating a health hazard. Additionally, while seemingly simple to produce, the friction-surface sheet material containing granules requires extremely careful coating conditions and particle size control, else a non-uniform surface product will be produced. Furthermore, while these prior art granule-containing sheets at first appear attractive, they may lose their attractive uniform surface as their upper surface of pigmented adhesive is abraded away during use, exposing the granules contained within, which are usually not the same color.

While, at first appearance, an easy solution to the inadequacies discussed above would seem to be to simply emboss a thermoplastic sheet to impart a friction surface, attempts to produce such a sheet have yielded inferior products. Embossing an unsupported layer of a tough scuff-resistant thermoplastic resin, however, results in a product which lacks dimensional stability and easily distorts in use. Laminating a layer of embossable thermoplastic resin to a dimensionally stable backing such as heat-set, biaxially oriented polyethylene terephthalate is difficult because of the latter's non-adherent surface, which virtually defies permanent adhesion thereto by resins having the desired properties for the embossed layer. Products have been made by interposing a normally tacky and pressure-sensitive adhesive layer between the backing layer and the embossed upper layer, but these are expensive to make and eventually delaminate in use or upon subsequent removal from a substrate after use, leaving a difficult to remove residue.

Despite the fact that friction-surface sheets have been known for more than a decade, no adequate solution has been provided for the inadequacies set forth above, prior to the present invention.

SUMMARY

The present invention provides a friction-surface sheet which can be rapidly and economically produced in large quantities, without the use of granules and without the special coating techniques associated therewith. The sheet has the desired frictional characteristic, dimensional stability, abrasion resistance, moisture resistance, tear resistance, and crack resistance for the use described herein, combined with adequate elongation, stretchability, and deformability to provide a long-lasting, effective, frictional surface sheet under virtually all climatic conditions.

The friction-surface sheet of the invention is comprised of a flat layer of biaxially oriented, heat-set polyethylene terephthalate of uniform thickness and having adherently bonded to its upper surface an embossed, textured, tough, scuff-resistant, weather-resistant layer of certain thermoplastic ethylenic copolymers, and a pressure-sensitive adhesive layer adherently bonded to its lower surface.

The friction-surface sheet can be made by coating a thin, ultra-violet light transmissive, self-sustaining, coherent layer of film-forming thermoplastic polymer onto the polyethylene terephthalate layer, irradiating the layer interface with ultra-violet light for a time and at an intensity sufficient to create an adherent bond between the layers, coating molten ethylenic copolymer on top of the polymer layer to provide an embossable layer, and embossing the copolymer layer to impart the desired textured surface. Other ways of obtaining this laminated structure will also be disclosed. Normally tacky and pressure-sensitive adhesive is applied to the lower surface of the sheet thus described to facilitate mounting thereof to any of a variety of substrates.

BRIEF DESCRIPTION OF THE DRAWING

Understanding of the invention will be facilitated by referring to the accompanying drawing, wherein:

FIG. 1 is a schematic representation of the presently preferred method of preparing the friction-surface sheet of the invention;

FIG. 2 is a cross sectional view taken at line 2—2 of FIG. 1;

FIG. 3 is a cross sectional view taken at line 3—3 of FIG. 1;

FIG. 4 is a cross sectional view taken at line 4—4 of FIG. 1;

FIG. 5 is a cross sectional view taken at line 5—5 of FIG. 1; and

FIG. 6 is a cross sectional view showing the friction-surface sheet of the invention and is taken at line 6—6 of FIG. 1.

In accordance with the invention and as depicted in FIGS. 2–6, flat, biaxially oriented, heat-set polyethylene terephthalate film 11 of substantially uniform thickness is adherently bonded to thermoplastic polymer layer 13 which is adherently bonded to embossed layer 18 formed of a tough, flexible, scuff-resistant, weather-resistant, thermoplastic ethylenic copolymer. The opposite surface of polyethylene terephthalate film 11 is adherently bonded to normally tacky and pressure-sensitive adhesive layer 38 which may be protected prior to use by a suitable release liner 39. A prime coating 37 of rubber may be desired when rubber-base adhesive compositions are used as the pressure-sensitive layer.

PRESENTLY PREFERRED EMBODIMENT

As shown in FIG. 1, the friction-surface sheet material is prepared by first coating biaxially oriented heat-set polyethylene terephthalate film 11 obtained from supply roll 10. An ultra-violet light transmissive self-sustaining, coherent layer of thermoplastic polymer primer is extruded as a molten sheet 13*a* from extruder 12 onto the upper surface of film 11 to provide coated film 14. Coated film 14 is irradiated by ultra-violet light

source 15 through the coating at an intensity and for a time sufficient to cause adherent bonding between the coating and the polyethylene terephthalate film to produce primed laminate 16. (Further description of ultraviolet light coating techniques may be found in U.S. Pat. No. 3,188,266, incorporated herein by reference.) Molten copolymer as sheet 18a is extruded from extruder 17 onto the primed surface as the freshly coated composite film is simultaneously passed between embossing roll 20 and backup roll 19 to produce embossed film 21. After hardening, film 21 is passed under tension over decurling edge 23 between idler rolls 22 and 25 to make the textured surface convex. Decurled laminate 24 is then primed on its lower surface by roll coating a rubber/solvent priming solution 28 contained in vessel 29 with coater roll 27 which operates in opposition to backup roll 26. Rubber-coated composite film 30 is then dried of solvent at drying station 31 by use of either a circulating air source, oven, hot can dryer, or a combination thereof, providing rubber coated laminate 32. Laminate 32 is exposed to a second ultraviolet light source 33 through the rubber coat and irradiated therewith to cause a permanent adherent bond between the rubber layer and the polyethylene terephthalate film surface, providing composite film 34. Pressure-sensitive adhesive, as a self-supporting film (carried on a suitable release liner to prevent blocking) is then dispensed from roll 35 so that its exposed adhesive surface contacts the rubber-primed surface and this composite is passed between nip rolls 40 and 41 to consolidate the layers into an integral sheet which is wound as roll 36 for storage.

FIGS. 2–6 show the various stages of formation of the laminate formed by the process of FIG. 1. It is, of course, understood that the process may also be accomplished in individual steps wherein, after each process step which produces a handleable intermediate, the intermediate may be stored, and thereafter completed. For example, it may be desired to do some of the process steps at one location and others at another location.

Although the presently preferred embodiment specifies rubber-base normally tacky and pressure-sensitive adhesive applied over an initial prime coat, that is not the only type normally tacky adhesive which can be used. Other normally tacky and pressure-sensitive adhesives useful in the present invention will be exemplified and illustrated hereinafter.

Other ways of forming the friction-surface sheet material of the invention are possible and within the scope of the invention. For example, the polyethylene terephthalate and the copolymer layer may be coextruded to provide an integral composite film which can subsequently be biaxially oriented and heat-set. Additional copolymer is then coated on the composite's copolymer surface by melt fusion to provide the desired thickness for embossing as described above. Thereafter, adhesive is applied to the unembossed lower surface by the method disclosed above or by conventional adhesive coating techniques.

Coextrusion is a well known process wherein layers of thermoplastic materials are brought into contact while they are still molten. Formation and adhering of the layers takes place inside or immediately outside the extruding die, forming an integral composite. The composite film is thereafter endowed with improved physical properties by biaxial orientation and heat-setting. Biaxial orientation, as is also well known, involves stretching the film in two directions normal to each other, generally in the machine direction and at right angles thereto. In a typical operation, the freshly formed molten composite film is fed onto a cooling drum to produce a quenched amorphous film, which is briefly heated and stretched in the machine direction, and then conducted through a tenter frame where it is stretched transversely with moderate heating. Machine direction stretching may be accomplished by passing between two sets of nip rolls the second set rotating at a higher speed than the first. Stretching typically increases the film area by a factor of at least six, the stretching usually being equal in each direction.

Heat-setting, or heat stabilization, of the stretched composite film is accomplished by restraining the film at its stretched dimension and heating briefly, then quenching. Such heating is typically in the range of 175°–240°C.

DETAILED DESCRIPTION

The backing sheet of the friction-surface sheet material of the invention is, as previously discussed, formed of biaxially oriented, heat-set polyethylene terephthalate. Such a material is well known and commercially available under the trade designations "Mylar" and "Scotch Par". This film is noted for its toughness, dimensional stability and inertness under a wide variety of conditions. For the invention, it has been found useful to use such film at thicknesses on the order of 1 to 5 mils. Film widths will vary depending upon the processing equipment, typically between 24 and 60 inches.

The priming polymer coated on the upper surface of the polyethylene terephthalate film is a film-forming thermoplastic capable of being formed into highly coherent, self-sustaining film which is transmissive to ultra-violet light, capable of forming an adherent bond with the polyethylene terephthalate film under the influence of ultra-violet irradiation, and capable of forming an adherent bond with the upper copolymer layer discussed hereinafter by melt fusion. The priming polymer layer should be thin enough to permit irradiation through its thickness, not contain ultra-violet light absorbing fillers, and be sufficiently coherent to resist cohesive failure when used as herein disclosed. Typically, the prime layer will be on the order of 0.5 to 3 mils thick. Suitable polymeric materials found useful for the prime layer include polymers of ethylene such as polyethylene and ethylene ethyl acrylate and ethylene vinyl acetate copolymers.

The upper, embossed layer is of an ethylene copolymer which is tough, scuff-resistant, moisture-resistant, weather-resistant, and flexible. This copolymer should also have a hardness value within the range of about 60–95 Shore A durometer (preferably 70–90), be resistant to permanent deformation at temperatures below about 90°C, have a dynamic coefficient of friction with respect to dry leather greater than 0.45 when embossed, have a tensile strength of at least 700 psi, and have an elongation of at least 100%.

The dynamic coefficient of friction of the embossed layer is determined by utilizing the procedure described in *Military Specification: Walkway Compound, Nonslip, and Walkway Matting, Nonslip* (MIL-W-5044C), dated Aug. 25, 1970. According to this publication, two pieces of vegetable-tanned cattlehide sole leather, ¼ by ½ inch by 10 inches are bonded to a 1 by

5 by 10.5 inch block of maple. Weights are added to provide a total weight of 20 pounds. The strips extend lengthwise symmetrically and about 4 inches apart of the 5 by 10.5 inch face of the block, with the flesh surfaces of the leather exposed. The exposed leather surfaces are lightly sanded before each run with 2/0 garnet paper and wiped clean of sanded particles with a cloth. The test block is placed on the leather strips on one end of an 18 inch long by 6 inch wide test panel adhered to a level surface and the load required to pull the block 7 inches across the panel at a speed of 20 inches per minute is recorded. Three runs on each test speciman are made and averaged. The dynamic coefficient of friction is the average load divided by the weight of the block.

Embossed polymer surfaces having a dynamic coefficient of friction less than 0.45 on dry leather are deemed too slippery for use as nonslip or friction-surface sheet material.

Copolymers suitable for use in the invention and having the properties described above include ethylenic copolymers (and terpolymers) such as prepared from ethylene and olefinically unsaturated monomers such as alkyl acrylates, propylene, vinyl acetate, butadiene, hexadienes, and combinations thereof. Commercially available forms of such copolymers include ethylene ethyl acrylate copolymers such as that sold under the trade designations "Bakelite DPD 6169" and "Bakelite DPD 6182", ethylene vinyl acetate such as that sold under the trade designations "Bakelite DQD 1868", "Bakelite DQD 6182", "Elvax 260" and Ultrathene UE 645X", "Ultrathene 637", "Ultrathene 630-81" and "Ultrathene 631", and ethylene propylene diene terpolymers such as those sold under the trade designations "Nordel 1500", "TPR 1900" and "TPR 2000".

The copolymer comprising the upper surface of the friction-surface sheet of the invention may incorporate fillers or pigments to impart color or improve the physical properties in this layer. Such fillers, which include carbon black, clays, magnesium oxide, reclaimed rubber, fine scrap rubber particles, process oils, and other materials known in the art, can be used up to 70% by weight of the total weight of this layer. The fillers may be added to the copolymer prior to extruding it onto the backing film, by milling, mixing such as in a "Banbury" machine, and in other ways known in the art.

The copolymer layer will typically have an average thickness on the order of 10 to 60 mils, and when embossed, will typically have a thickness on the order of 3 to 25 mils or more at its thinnest portion (at the valleys).

The rubber prime coat, for promoting adhesion between a rubber base pressure-sensitive adhesive and the lower surface of the polyethylene terephthalate film, may be applied as a solution of natural rubber in an organic solvent such as heptane or trichloroethylene, typically on the order of 2 to 3% by weight rubber. This prime layer, which will be typically less than about 0.5 mil thick, can be eliminated and the rubber-base adhesive merely coated directly by conventional techniques upon the polyethylene terephthalate backing film surface, but priming provides a bond of superior strength between the backing film and the rubber base adhesive and, therefore, is preferred.

The rubber base adhesive most preferred for use on the friction-surface sheet material of the invention is a tacky, pressure-sensitive, abrasion-resistant, bakelized crude rubber adhesive. This type of adhesive is disclosed in U.S. Pat. Nos. 2,269,712, 2,410,079, and 2,177,627, each of which is incorporated herein by reference. Other normally tacky and pressure-sensitive adhesives which can be used include the tackified AB block copolymer adhesives disclosed in U.S. pat. application Ser. No. 146,473, filed May 21, 1971, now U.S. Pat. No. 3,787,531, by Carl A. Dahlquist and Vasant V. Kolpe, which application is incorporated herein by reference and acrylate adhesives disclosed in U.S. Pat. No. Re. 24,906, also incorporated by reference. The pressure-sensitive adhesive layer is preferably on the order of 2 to 10 mils in thickness.

The roll used to emboss the copolymer layer has a surface which is the counterpart of that desired for the friction-surface sheet material of the invention. The roll surface may be generated by engraving, rough sandblasting, or other ways which involve imparting a textured surface to a smooth cylindrical metal roll. The textured surface may have a uniform pattern, include indicia, or may be of random nature, as long as it embosses the desired textured surface into the sheet material.

One method of preparing an embossing roll suitable for use in the invention is by shaping an original which may be a prior art friction-surface sheet into a tubular form (with the textured surface forming the inner surface of the tube), supporting the tube in a temporary rigid tubular structure, sensitizing the textured surface so that metal can be electrically deposited thereon, and electrically depositing metal to build up a rigid structure suitable for use as an embossing roll. The temporary rigid structure and the original are then removed to reveal the embossing roll which can be supported for rotation. This method of producing an embossing roll is disclosed in U.S. Pat. No. 2,749,294.

The invention is further illustrated by reference to the following examples, in which all parts and percentages are by weight unless otherwise noted.

EXAMPLE 1

A 26 inch wide, 3 mil thick continuous sheet of biaxially oriented, heat-set polyethylene terephthalate (commercially available under the trade designation "Scotch Par" from the 3M Company) was primed by extruding a 1 mil thick layer of ethylene ethyl acrylate copolymer having a melt index of 6 (commercially available under the trade designation "Bakelite DFDA 6169" from the Union Carbide Company) thereon as a uniform layer. The extruder has barrel temperatures of 150°C, 200°C, 260°C, 280°C and 290°C, respectively, gate temperature of 290°C, die neck temperature of 290°C, die temperature of 290°C, and end plate temperatures of 290°C. The coating was permitted to cool and the coated polyethylene terephthalate film was passed, film side in, around a 6 ft. diameter hot can (130°C surface temperature) approximately 1 inch from 120 equally spaced type G 64T6 tubular ultraviolet lights arranged in 270° wrapped within a shroud around the hot can to provide an irradiation residence time of about 0.2 minute, with the coated side facing the ultra-violet lights. The polyethylene terephthalate film was then coated using a second extruder on the primed surface with a blend of (1) 94.5 parts ethylene ethyl acrylate copolymer consisting of 18% ethylacrylate and 82% ethylene (sold under the trade designation "Bakelite DFD 6169" by the Union Carbide Co.)

(2) 5 parts of a predispersed mixture of one titanium dioxide in one part low density polyethylene available under the trade designation "PMS 08500" (3) 0.2 part of a bacteriostat (sold under the trade designation "Vancide 89") and (4) 0.25 parts of a ultra-violet light absorber ("Cyasorb UV531") at an average thickness of 15 mils. The second extruder has barrel temperatures of 120°C, 140°C, 160°C and 165°C, respectively, a neck temperature of 145°C, and a die temperature of 155°–170°C. The coated film was then passed between an 8 inch diameter textured surface embossing roll and an 8 inch diameter rubber backup roll having a Shore A hardness value of 60–80 with the copolymer surface exposed to the embossing roll, providing an embossed textured surface ethylene ethyl acrylate copolymer layer. Since this film had a tendency to curl away from the polyethylene terephthalate side, it was decurled by passing between idler rolls over a decurling tension bar while under tension of about 400 pounds with the polyethylene terephthalate surface against the bar. The decurled laminate was roll coated on the remaining polyethylene terephthalate surface with a 2.8% natural rubber/heptane solution having a viscosity of about 150–200 cps. A very thin rubber coating (less than 0.5 mil in thickness) resulted, once the coating had been dried by passing it over a 68°C hot can. The rubber coating was irradiated from a distance of 1 inch with an ultra-violet light source consisting of 18 G 64T6 lamps arranged ¾ inches apart in a 2½ feet linear pattern with a residence time of 0.1 minute. Thereafter, a self-supporting, 4 mil thick, bakelized pressure-sensitive tacky adhesive composition prepared by mixing of equal parts of Part A and Part B described in the table below and sufficient heptane/ethanol (97/3) solution to make the viscosity 5000 cps, coating the mixture on a silicone oil coated paper release liner, and evaporating the solvent. The resultant adhesive layer was laminated to the rubber-primed side of the polyethylene terephthalate film by passing the superimposed layers between nip rolls consisting of an 11.5 inch diameter metal roll and 9.5 inch diameter rubber roll having a Shore A hardness of approximately 60 to 80 at a roll to roll pressure of 15 pounds per inch of width of contact.

Rubber Base Pressure-Sensitive Adhesive

Part A

Ingredient	Parts by Weight
Crude rubber	100.0
Zinc oxide	66.00
Anhydrous lanolin	6.75
Natural pine rosin ("Nelio N Gum")	6.75
Oil-soluble heat-reactive para-substituted phenol aldehyde tackifier resin ("Bakelite CKR-1634")	4.38
Heptane	226
Denatured ethyl alcohol	25

Part B

Ingredient	Parts by Weight
Pale crepe rubber	100
Polyterpene tackifier ("Piccolyte-S-115" resin)	47.2
Zinc resinate having a melting point of 164°C and acid number of zero ("Zirex Resin")	9.42
Tricresyl phosphate	4.69
2,5-di-tert-amylhydroquinone antioxidant ("Santovar A")	2.03

-Continued

Rubber Base Pressure-Sensitive Adhesive

Part B

Ingredient	Parts by Weight
Oil-soluble heat-reactive para-substituted phenol aldehyde tackifier resin ("Bakelite CKR-1634")	5.69
Titanium dioxide	3.86
Carbon black	0.08
Cyclohexylamine	0.02
Denatured ethyl alcohol	18.82
Toluene	18.82
Heptane	451

The resultant friction-surface sheet (less the release liner), which had a roughened surface, overall thickness of 30 mils and an average thickness of 23 mils, provided an excellent underfoot friction-surface when cut to size and applied to stairs, bath tubs and showers.

EXAMPLE 2

An embossed layer adherently bonded to polyethylene terephthalate backing film was prepared according to Example 1 and to such a structure was bonded 5 mils of a polystyrene polyisoprene AB block copolymer prepared according to Example 1 of aforementioned U.S. patent application Ser. No. 146,473. The A block was polystyrene having a molecular weight of 45,000 and the B block was polyisoprene having a molecular weight of 105,000. The adhesive was of the following ingredients:

AB Block Copolymer Adhesive

Ingredients	Parts
AB block copolymer	100
Petroleum resin tackifier ("Wingtack 95")	25
Antioxidant ("Irganox 1076")	2
Titanium dioxide	0.5

EXAMPLE 3

A friction-surface sheet product was formed by adhering to the polyethylene terephthalate surface of embossed upper layer/backing film of Example 1 a pressure-sensitive adhesive containing the AB block copolymer described in Example 2 and multi-block copolymer (3 block copolymer) sold under the trade designation "Kraton 1108". The adhesive contained the following ingredients:

AB/Multi-Block Copolymer Adhesive

Ingredients	Parts
Multi-block copolymer ("Kraton 1108")	23
AB block copolymer	77
Petroleum resin tackifier ("Wingtack 95")	35
Antioxidant (*"Irganox 1076")	2
Titanium dioxide	0.5

EXAMPLE 4

The friction-surface sheet material's adhesive was of a multi-block copolymer of the following ingredients:

Multi-Block Copolymer Adhesive

Ingredients	Parts
Multi-block copolymer ("Kraton 1108")	100
Polyterpene tackifier resin ("Piccolyte S-115")	100
Aliphatic process oil ("Sun Par 2280")	10

EXAMPLE 5

The friction-surface sheet material's adhesive was a normally tacky and pressure-sensitive 10:90 acrylic acid:isooctyl arylate copolymer such as described in Example 7 of U.S. Pat. No. Re.24,906.

EXAMPLE 6

A friction-surface sheet material was prepared according to Example 1 except the upper surface polyethylene terephthalate prime coating was replaced by an ethyl vinyl acetate copolymer (sold under the trade designation "Bakelite DQDA 3737" by the Union Carbide Co.) For this material the extruder had barrel temperatures of 110°C, 130°C and 150°C, a neck temperature of 150°C, a die body temperature of 150°C and gate temperatures of 150°C.

EXAMPLE 7

The polyethylene terephthalate backing film was prepared by coextrusion with thermoplastic polyester ("Hytrel 4055") to form a 3 mil composite film having a 0.75 mil polyethylene terephthalate layer, after orientation and heatsetting. The polyester (Hytrel 4055) extruder had barrel temperatures about 140°C, 185°C, 190°C and 225°C, and a die temperature about 225°C. The composite was oriented at 80°C by stretching 2.8 times in the machine direction and 2.8 times in the transverse direction, and heat-set by heating at 190°C for 12 seconds.

The polyester (Hytrel 4055) surface was coated (without additional primer) with ethylene ethyl acrylate copolymer ("Bakelite DFDA 6169), embossed and bonded to an adhesive layer as described in Example 1.

EXAMPLE 8

A 2 mil thick polyethylene ("DFD 4947") prime coating was extrusion coated on 2 mil thick biaxially oriented, heat-set polyethylene terephthalate backing and irradiated according to Example 1. The polyethylene layer surface was overcoated with a mixture of 99 parts ethylene propylene diene terpolymer ("TPR-2000") and 1 part carbon black which was embossed to provide a 42 mil thick embossed laminate. The underside of the laminate (the polyethylene terephthalate surface) was primed with natural rubber as described in Example 1 and coated with a pressure-sensitive adhesive consisting of the ingredients designated Part B in Example 1.

EXAMPLE 9

A polyethylene terephthalate film primed on its upper surface as described in Example 1 was overcoated with ethylene vinyl acetate copolymer (sold under the trade designation "Ultrathene 645") and embossed as described in Example 1 to provide a friction-surface sheet.

EXAMPLE 10

The embossable copolymer upper layer was a mixture of (1) 20 parts ethylene vinyl acetate copolymer ("Elvax 260") (2) 20 parts powdered polyethylene ("Microthene 715") and (3) 60 parts shredded scrap rubber tire filler (screened through "Tyler" 12 mesh screen having about 1.41 mm openings). The scrap rubber was a filler which did not undesirably increase the hardness. The copolymer was ground to a powder and mixed with the polyethylene and filler in a two stage polyethylene extruder having barrel temperatures of 140°C, 190°C, 200°C and 205°C, a neck temperature of 205°C and a die temperature of 200°–210°C. The copolymer was coated on a primed polyethylene terephthalate film prepared according to Example 1 and embossed to produce a friction-surface sheet.

What is claimed is:

1. Friction-surface sheet material especially useful for providing a safe frictional walk-on surface for stairs, in bath tubs and showers, and on other surfaces which may be inherently undesirably slippery, comprising in combination:

a heat-set, biaxially oriented, polyethylene terephthalate backing having a thickness of about 1 to about 5 mils,

an ultraviolet light transmissive ethylene polymer prime layer, adherently bonded to one major surface of said polyethylene terephthalate backing,

adherently bonded to the primed surface of said backing a layer of embossed, textured, tough, scuff-resistant, weather-resistant, flexible ethylenic copolymer material having a Shore A durometer hardness value within the range of about 60–95, said layer being resistant to permanent deformation at temperatures below 90°C, having a tensile strength of at least 700 psi, a dynamic co-efficient of friction greater than 0.45 and an elongation of at least 100%; and

about 2 to about 10 mils of normally tacky and pressure-sensitive adhesive uniformly coated over and adherently bonded to the opposite major surface of said backing.

2. The friction-surface sheet material of claim 1 wherein said ethylenic copolymer is an ethylenic copolymer or terpolymer formed from ethylene and olefinically unsaturated monomers selected from the group consisting of alkyl acrylates, propylene, vinyl acetate, butadiene, hexadienes, and combinations thereof.

3. The friction-surface sheet material of claim 1 including a natural rubber prime layer interposed between said polyethylene terephthalate layer and said adhesive layer, and wherein said adhesive is a rubber base adhesive.

4. The friction-surface sheet material of claim 1 wherein said ethylenic copolymer layer is formed of ethylene acrylate copolymer.

5. The friction-surface sheet material of claim 1 wherein said adhesive is selected from the group consisting of acrylate adhesives and AB block copolymer adhesives.

6. The friction-surface sheet material of claim 5 wherein said AB block copolymer adhesive also contains multi-block copolymer having at least 3 connected polymer blocks.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,895,153
DATED : July 15, 1975
INVENTOR(S) : Manley R. Johnston and Roger P. Goepninger

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 12, change "25,788" to --25,778--

Col. 7, line 1, change "one titanium" to --one part titanium--

Col. 9, line 15, change "arylate" to --acrylate--

Claim 4, line 3, after "ethylene" and before "acrylate", --ethyl-- should be inserted.

Signed and Sealed this

fourteenth Day of *October 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

ATTORNEY DOCKET NO. 5923.0001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	Goecke
TITLE	:	Adhesive Tape
SERIAL NO.	:	10/674,108
FILING DATE	:	September 29, 2003
ART UNIT	:	1788
CONFIRMATION NO.	:	2438
ATTORNEY DOCKET NO.	:	5923.0001

Exhibit F

Reeves U.S. Patent 5,508,084

US005508084A

United States Patent [19]

Reeves et al.

[11] Patent Number: 5,508,084

[45] Date of Patent: *Apr. 16, 1996

[54] **REPOSITIONABLE ARTICLES HAVING A MICROSTRUCTURED SURFACE, KITS FOR PRODUCING SAME, AND METHODS OF USE**

[75] Inventors: **Mark E. Reeves**, Maplewood; **Diwakaran A. Ratnam**, St. Paul, both of Minn.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,234,740.

[73] Assignee: **Minnesota Mining and Manufacturing Company**, St. Paul, Minn.

[21] Appl. No.: **248,863**

[22] Filed: **May 24, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 929,685, Aug. 13, 1992, which is a continuation-in-part of Ser. No. 751,147, Aug. 28, 1991, Pat. No. 5,234,740.

[51] **Int. Cl.**[6] **B32B 3/28**

[52] **U.S. Cl.** **428/172**; 428/141; 428/156; 428/346

[58] **Field of Search** 428/156, 172, 428/343, 76, 167, 178, 174, 95, 96, 346, 354, 542.8, 40

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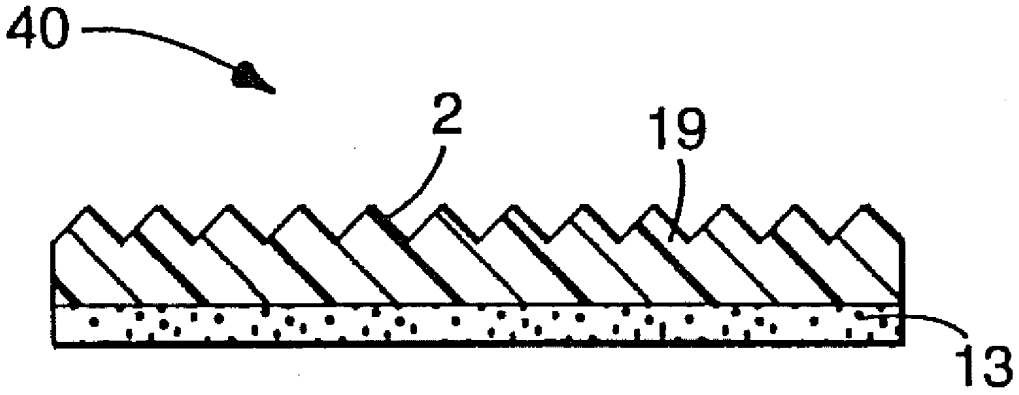
Primary Examiner—Donald J. Loney

Attorney, Agent, or Firm—Gary L. Griswold; Walter N. Kirn; Carolyn V. Peters

[57] **ABSTRACT**

A repositionable article having a microstructured surface is described which includes a removable and rebondable adhesive layer having first and second surfaces and a control layer having a control surface and a back surface, the second surface of the adhesive layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions. The articles find use particularly as mouse pads.

48 Claims, 4 Drawing Sheets



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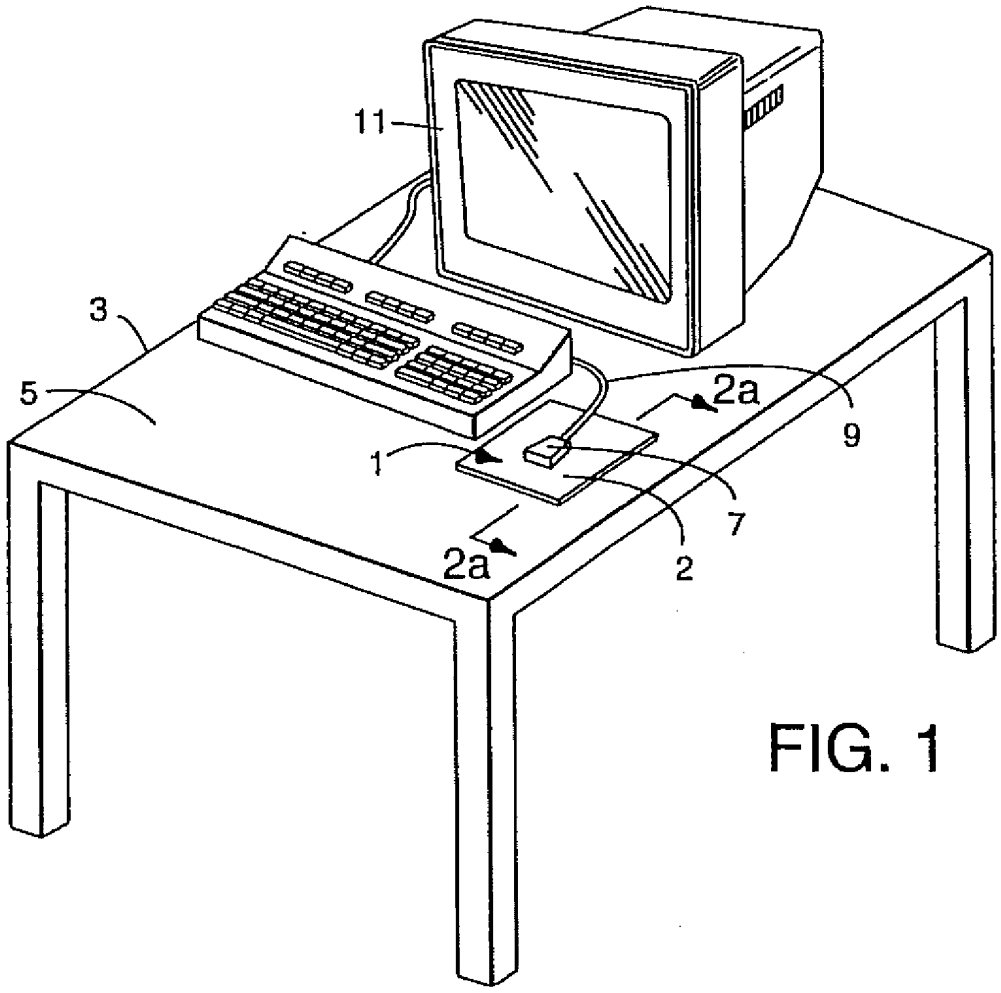

FIG. 1

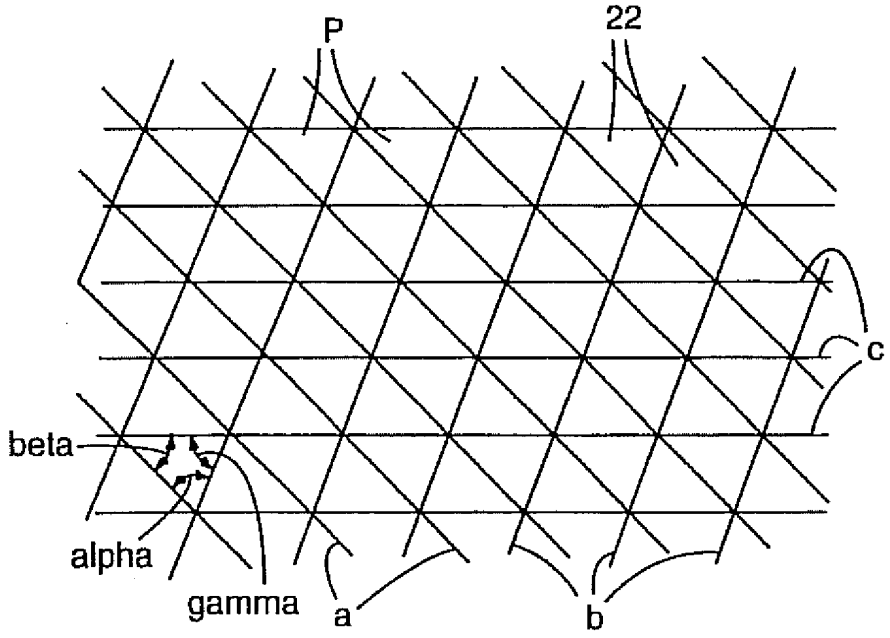

FIG. 1a

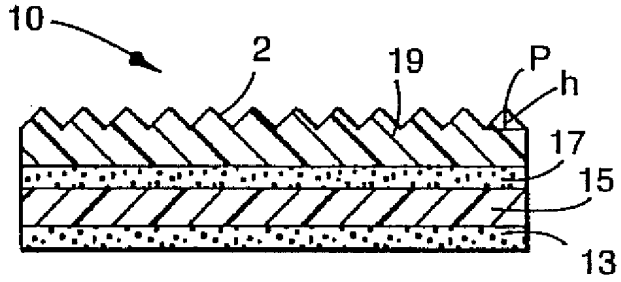

FIG. 2a

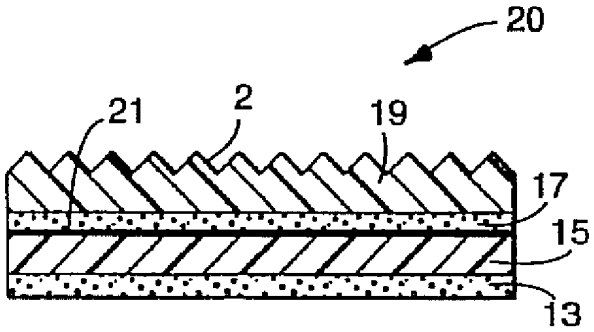

FIG. 2b

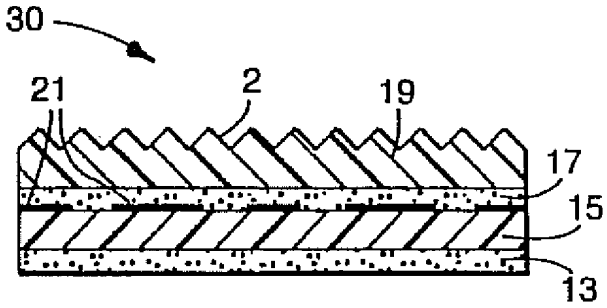

FIG. 2c

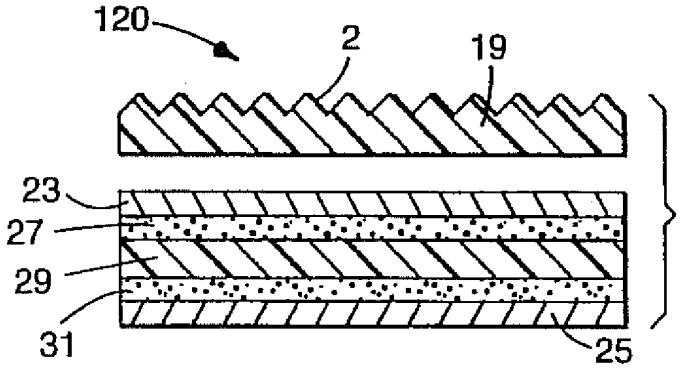

FIG. 8

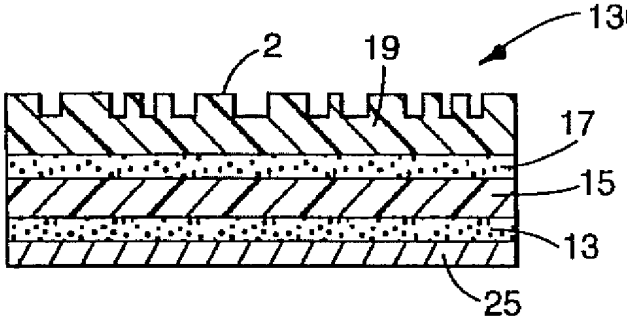

FIG. 9

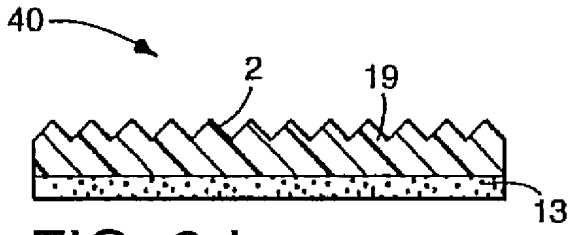

FIG. 2d

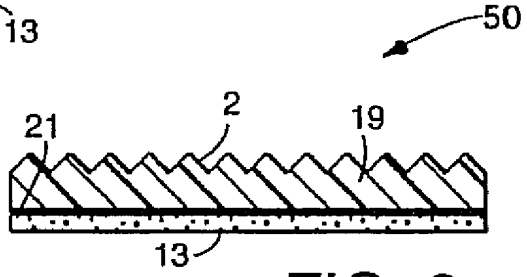

FIG. 2e

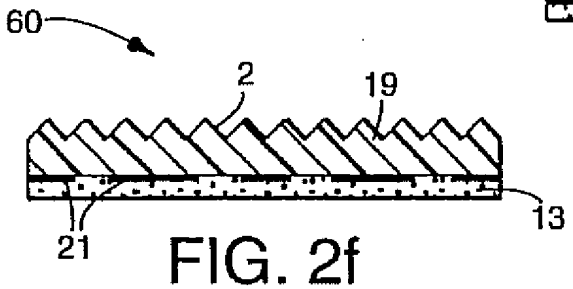

FIG. 2f

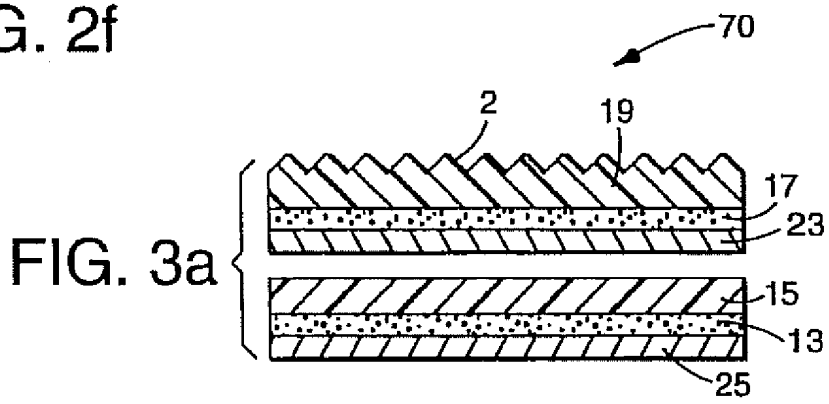

FIG. 3a

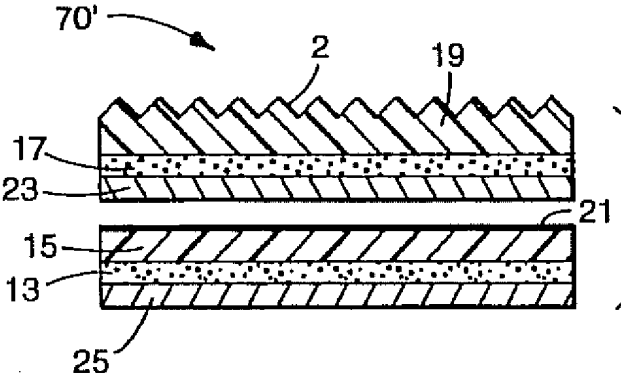

FIG. 3b

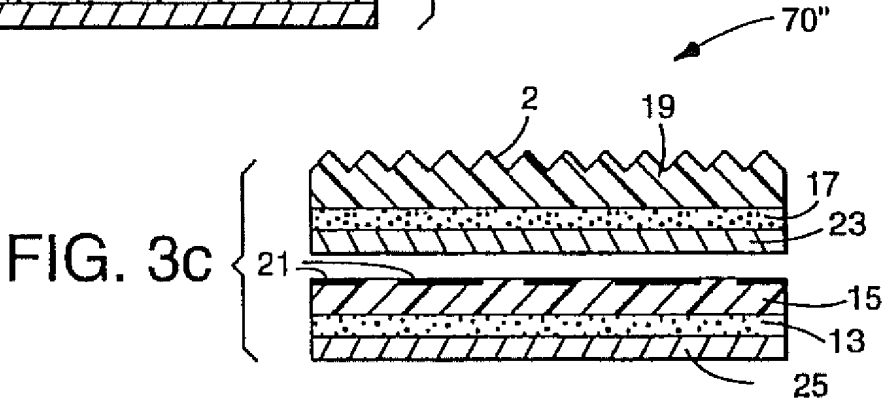

FIG. 3c

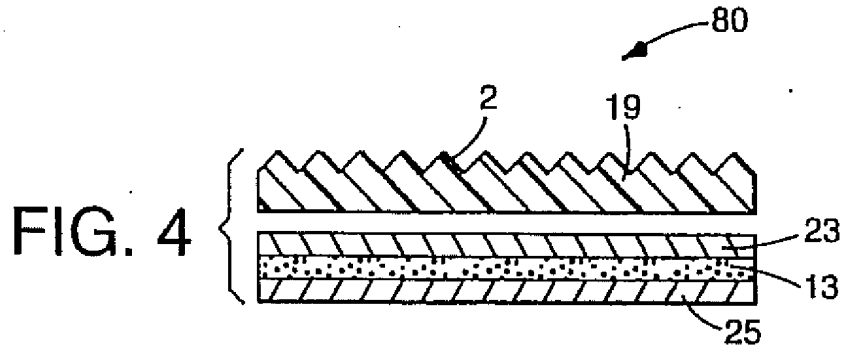

FIG. 4

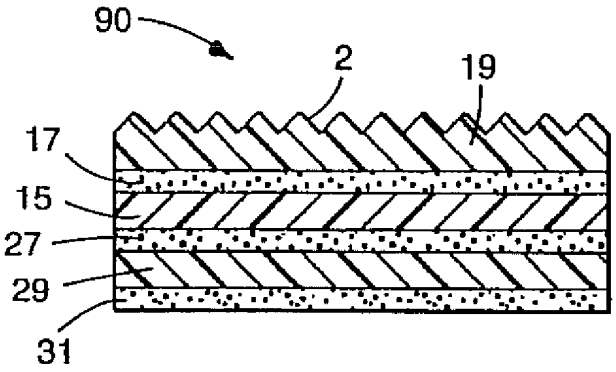

FIG. 5

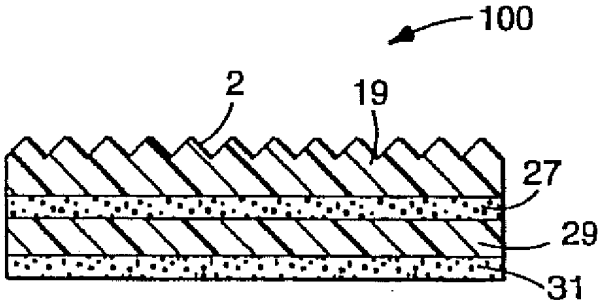

FIG. 6

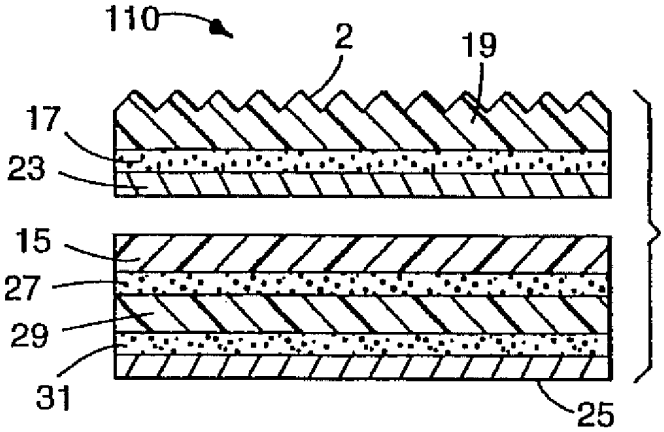

FIG. 7

REPOSITIONABLE ARTICLES HAVING A MICROSTRUCTURED SURFACE, KITS FOR PRODUCING SAME, AND METHODS OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 07/929,685, filed Aug. 13, 1992, which was a continuation-in-part of application Ser. No. 07/751,147, filed Aug. 28, 1991, now U.S. Pat. No. 5,234,740.

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to printable, removable adhesive-fastened articles having a microstructured surface on their nonadhesive side, which are useful as a pad over which hand-held pointing devices may traverse.

2. Background Art

Many computers for use in the home or office are equipped with a hand-held pointing device, commonly referred to as a "mouse" because of their appearance. The mouse controls a pointer or cursor on the computer screen. A typical mouse has a rubber or rubber-coated "track ball" which contacts a surface, such as a desk top. Smooth and textured metallic track balls are also known. The track ball rolls within a socket within the mouse body. The mouse translates the movement of the track ball, in cooperation with the necessary computer hardware and software, into signals that tell the computer how to move the pointer.

Mice of the type previously described are generally referred to as mechanical mice. Other types of mice convert the movement of the track ball to an optical signal which is then converted into corresponding electrical signal (optomechanical mice).

A mouse will typically have one or more mouse buttons accessible to the user which the user may depress. In some cases, mouse buttons may be depressed simultaneously with the movement of the mouse across the surface, a procedure commonly known as "dragging." Dragging lets the user select a portion of the screen or move objects around the screen. In some mice of the type described, moving the mouse slowly results in small movements of the pointer, while moving the mouse faster results larger pointer movements.

In all of the above-mentioned mouse movements, both the mouse-to-pointer movement relationship and comfort are important to the user. It is frequently desired to cover large distances on the screen with minimum mouse movement, while retaining precise pointer control when the pointer approaches the desired object. It is also preferable to move the mouse with as much comfort to the user's hand and wrist as possible, avoiding step-like movements as might accompany the hand traversing a raised edge of the desk, or jerky movements across the desk made possible by dust, dirt, oil or food particles on the desk.

It is common for human users of interactive computers employing a mouse, particularly in office and home settings, to place the computer on decorative wooden or other furniture which may be subject to scratches and dents by mouse movements. If the furniture is wood, oils or other slippery materials may be present in furniture polish. These materials, food grease and food particles, dust, dirt, and the like, may accumulate on such surfaces and come between the mouse and the surface thus rendering the mouse movement on the pad, and the cursor movement, less effective than desired. As such, most users would rather not have the mouse traverse the surface of the desk per se, but commonly employ a "mouse pad" to both protect the surface and retain precision pointer movements. One popular mouse pad comprises a thin woven or nonwoven surface over which the mouse traverses, and the nonwoven or woven material may have logos, advertisements, or other graphic symbols printed thereon. Adhered to one side of the woven or nonwoven material opposite the side the mouse traverses is typically a flexible foam which is perhaps 0.125 to 0.5 inch (0.32 to 1.27 cm) thick. This foam backing may have a plurality of rubbery, knobby protuberances on its bottom surface (away from the mouse traversing surface) which provide frictional non-slip contact with the desk or other surface.

Home and office computer users also frequently desire to personalize their work stations. Mouse pads are available having means for changing graphic designs within an envelope created between the mouse-traversing surface layer of the pad and a base layer. The base layer is typically an open cell neoprene sponge rubber or other resilient layer to isolate the mouse traversing surface of the pad from unevenness in the desk upon which the mouse pad is placed. Unfortunately, the foam pads tend to present an uncomfortable step which the user's hand must traverse, at times presenting the user's wrist with an uncomfortable movement. Mouse pads of this type thus sacrifice some user comfort for precision in locating the cursor on the computer screen.

It would be an advancement in the mouse pad art to provide a pad which is more comfortable to the user than those having a thick backing, and which may be changeably customized or personalized to alternatively display family photos, important computer commands, cartoons, and the like on the pad. It would also be advantageous if the pad could easily be temporarily immobilized on the desk or other surface, then removed and moved to another surface, without damage to the surface and without leaving a residue on the surface. It also would be desirous to have a mouse pad having a uniform texture with good aggressive grab to the track ball providing a smooth, uniform, and predictable movement to the pointer on the screen, but not abrasive to the user's hand, while being possible of manufacture from almost any plastic material such as urethane or polyethylene.

SUMMARY OF INVENTION

In accordance with the present invention, repositionable articles having a microstructured surface are presented which are useful as a repositionable control surface for a personal computer pointing device (including a mouse or data pen). The articles of the invention may also serve as repositionable drink coasters and airline tray covers. The inventive articles can be adhered either permanently or temporarily to a surface, and can be repeatedly attached and removed from a surface. The articles may be customized with artwork, either by printing on the obverse or through a lamination process.

The articles of the invention have a control surface which is soft to the human touch, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions. The raised regions are preferably pyramidal. The phrase "an array of a plurality of precisely shaped raised regions and a plurality of recessed regions" is meant to distinguish over articles, such as paper, which have a smooth surface but microscopically have a textured surface.

Articles of the invention are especially useful as repositionable mouse pads due to excellent mouse tracking ball contact with the control surface. As the control layer may be formulated to contain water and oil repellant and soil resistant additives (or the control surface coated with same), the control surface will not get dirty from finger tip oils. The control layer is non-porous, will not shed lint and can be cleaned easily. Do to these properties, the articles of the invention advantageously keep the track ball cleaner for extended time periods.

In one embodiment the repositionable article having a microstructured surface comprises:

a) a removable and rebondable adhesive layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the second surface of the adhesive layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

Preferred articles of the invention are those wherein the removable and rebondable adhesive layer comprises an adhesive which is permanently bonded to the back surface of the control layer but remains rebondable to a surface such as a desk top and the like. Also preferred are control layers which are modified to include optional antistatic agents, water, oil and soil resistant additives and/or coatings, pigments and/or dyes, and the like, and those control layers which have printed information on the obverse. Optionally, the control surface may have these types of additives applied by the user as coatings from spray containers, as is commonly known.

As used herein the terms "removable and rebondable" and "repositionable", when referring to an adhesive layer, are interchangeable terms, and mean that the adhesive permits repeated cycles in which materials are alternatively bonded thereto and removed therefrom, while the adhesive is permanently retained on the back surface of the control layer. One suitable repositionable adhesive is the adhesive system described in the portion of assignee's U.S. Pat. No. 3,857,731 extending from column **2**, line **1** through column **10**, line **47**, which portion is incorporated by reference herein. This adhesive system comprises a binder material having embedded therein and protruding from the exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres. This adhesive system is further described herein. Adhesives exhibiting a peel adhesion ranging from about 2 to about 25 ounces per inch of width (about 22 to about 275 grams per cm of width) in a standard peel adhesion test are preferred.

In a second embodiment the repositionable article having a microstructured surface comprises:

a) a removable and rebondable first adhesive layer having first and second surfaces;

b) a substrate layer having first and second surfaces, the second surface of the first adhesive layer adhered to the first surface of the substrate layer;

c) a second adhesive layer having first and second surfaces, the first surface of the second adhesive layer adhered to the second surface of the substrate layer; and

d) a control layer having a control surface and a back surface, the back surface adhered to the second surface of the second adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

Preferred are those articles of the second embodiment in which the substrate layer is selected from the group consisting of plastic and paper, and the second adhesive layer is a permanent adhesive. The substrate layer may also be a foamed material, such as foamed neoprene, but this is not particularly preferred. The control surface preferably consists of a uniform array of a plurality of pyramids each having a height ranging from about 0.001 inch to about 0.040 inch (about 2.54×10^{-3} to about 0.1 cm). A graphic design may be adhered between the substrate layer and the second adhesive, or the design may be printed on the back surface of the control layer.

The articles of the first and second embodiments optionally include a release liner material removably attached to the rebondable adhesive.

Another embodiment of the invention is a kit adapted to be manipulated by the user to form a repositionable article having a microstructured surface. A first kit embodiment comprises:

a) a first sheet member consisting of:

1) a first release liner material having first and second surfaces;

2) a first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release liner material; and

3) a control layer having a control surface and a back surface, the back surface of the control layer adhered permanently to the first surface of the first adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions; and

b) a second sheet material consisting of:

1) a second release liner material having first and second surfaces;

2) a removable and rebondable second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the second release liner material; and

3) a substrate layer having first and second surfaces, the second surface of the substrate layer adhered to the first surface of the second adhesive layer, and the first surface of the substrate layer adapted to be permanently adhered to the first surface of the first adhesive layer when the first release material is removed from the first adhesive layer and the first adhesive layer and substrate layer are joined.

Preferred are those kits comprising a graphic layer, the graphic layer positioned either between the first adhesive layer and the control layer (or printed on the back surface of the control layer), or adhered to the second surface of the substrate layer.

Another kit embodiment, adapted to be manipulated by the user into a repositionable article having microstructured surface, comprises:

a) a first sheet material having a control surface and a back surface, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions; and

b) a second sheet material comprising:

1) a first release material having first and second surfaces;

2) a removable and rebondable adhesive layer adapted to be attached to the back surface of the control layer, the adhesive layer having first and second surfaces, the second surface of the adhesive layer removably adhered to the first surface of the first release material; and

3) a second release material having first and second surfaces, the second surface of the second release

material removably adhered to the first surface of the adhesive layer.

Yet another embodiment of the invention is a repositionable article having a microstructured surface comprising:

a) a removable and rebondable first adhesive layer having first and second surfaces;

b) a first substrate material having first and second surfaces, the second surface of the first substrate material adhered to the first surface of the first adhesive layer;

c) a second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the first substrate layer;

d) a second substrate layer having first and second surfaces, the second surface of the second substrate layer adhered to the first surface of the second adhesive layer;

e) a third adhesive layer having first and second surfaces, the second surface of the third adhesive layer adhered to the first surface of the second substrate material; and

f) a control layer having a control surface and back surface, the back surface of the control layer adhered to the first surface of the third adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

Preferred are those articles within this embodiment wherein a graphics layer is positioned between the second substrate layer and the third adhesive layer.

Still another embodiment of the invention is a repositionable article having a microstructured surface comprising:

a) a removable and rebondable first adhesive layer having first and second surfaces;

b) a substrate layer having first and second surfaces, the second surface of the substrate layer adhered to the first surface of the first adhesive layer;

c) a second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the substrate layer;

d) a control layer having a control surface and a back surface, the back surface of the control layer adhered to the first surface of the second adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

Another kit of the invention includes first and second sheet-like articles, the kit comprising;

a) the first sheet-like article consisting of:

1) a first release material having first and second surfaces;

2) a first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release layer; and

3) a control layer having a control surface and a back surface, the back surface adhered to the first surface of the first adhesive layer, the control layer defined as above; and

b) said second sheet-like article consisting of:

1) a second release material having first and second surfaces;

2) a removable and rebondable second adhesive layer having first and second surfaces, the second surface of the second adhesive layer removably adhered to the first surface of the second release material;

3) a first substrate layer having first and second surfaces, the second surface of the first substrate layer adhered to the first surface of the second adhesive layer;

4) a third adhesive layer having first and second surfaces, the second surface of a third adhesive layer adhered to the first surface of the first substrate layer; and

5) a second substrate layer having first and second surfaces, the second surface of the second substrate layer adhered to the first surface of the third adhesive layer.

An alternative kit including first and second sheet-like articles comprises;

a) a first sheet-like article consisting of a control layer having a control surface and a back surface, the back surface adapted to be contacted with a second sheet-like article, the control surface defined as above; and

b) a second sheet-like material consisting of:

1) a first release material having first and second surfaces;

2) a removable and rebondable first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release material;

3) a substrate layer having first and second surfaces, the second surface of the substrate layer adhered to the first surface of the first adhesive layer;

4) a second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the substrate layer; and

5) a second release material having first and second surfaces, the second surface of the second release material removably adhered to the first surface of the second adhesive layer, the second release material and the first release material adapted to be removed from the second sheet-like article, and the first surface of the second adhesive layer adapted to be adhered to the second surface of the control layer.

The articles of the invention may be:

(a) packaged flat with overlapping articles, wherein the adhesive is covered with a release liner;

(b) packaged flat with overlapping articles, adhesive unlinered;

(c) rolled onto itself such that the adhesive is not exposed but is covered up by subsequent layers.

(d) folded onto itself, adhesive against adhesive, such that the rebondable adhesive remains clean until used.

Thus, the invention further includes a support article from which repositionable articles can be removed, the support article comprising a plurality of repositionable articles each having a microstructured surface, each repositionable article comprising:

a) a removable and rebondable adhesive layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the back surface of the adhesive layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions,

the repositionable articles being relatively disposed so that at least a portion of the control surface contacts at least a portion of the first surface of the adhesive layer of an underlying repositionable article. Preferred support articles are those wherein the repositionable articles are disposed in the form of a stack or roll of repositionable articles, and

support articles upon which are mounted one or more of the repositionable articles.

A final embodiment comprises a repositionable article having a microstructured surface comprising:

a) a non-adhesive, high friction layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the second surface of the non-adhesive, high friction layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

It will be understood that the repositionable adhesive in all other embodiments may be substituted with the non-adhesive, high friction materials.

There are many advantages of the articles and kits of the present invention when used as mouse pads when compared with the conventional foam-backed mouse pads. Preferably, the articles of the invention are constructed such that the total thickness (i.e. the thickness measured from the desk or table surface to the point of the article most distal from the desk surface) is less than ¼ inch (6.35 mm), preferably less than 1/16 inch (about 1.6 mm), but in all cases more than 0.05 mm. In survey tests of users comparing the inventive articles with those of the type having ¼ inch or greater thick foam backing, it was found that thicknesses within these ranges endow the inventive articles with significant ergonomic advantage. The inventive article's low height (i.e. low thickness value) still allows the area of the desk or other surface covered by the article (sometimes referred to as the "mouse area") to be used as a normal desk surface. Papers can easily be slid over it, as can a keyboard. The control layer film is preferably transparent. Graphic artwork can be laminated to the obverse yet remain clear and legible, and the size and shape of the inventive articles can be easily customized using scissors.

The inventive articles are of suitable flexibility such that they will lay flat on a surface even after being flexed. The inventive articles are preferably sufficiently resilient so that the article bends as it is peeled off a desk or other surface, but which is supple so that the article flattens out easily upon reattaching to the desk. Typically, articles of the invention are sufficiently flexible to be wound about themselves on a 1 inch (2.54 cm) diameter mandrel.

The control surface may have a border or other defined portion which is not microstructured. For example, the peripheral border of the control surface may be stippled such that it is similar to the surface obtained by plasma coating. Alternatively, a portion or all of the control surface may be created through a knurling process yielding less uniform results.

The control layer of the articles of the invention has a control surface defined by an array of precisely shaped protrusions, preferably pyramids or pyramidal frustums, that are specially configured to provide desired traction control properties. Although uniform, nonrandom arrays are preferred in some instances, random arrays may be preferred in other end uses.

Adapted to be repositionably secured to the surface of a desk or other apparatus, the articles of the invention comprise at least one of (1) a repositionable adhesive layer on the surface of the article proximal to the desk surface, or (2) a high-friction surface which replaces the repositionable adhesive, such as a coating of rubber (neoprene, chloroprene, and the like), or (3) the control layer can be adhered to a desk or other surface through the use of surface tension effects, through a vacuum formed by air exclusion or through a highly plasticized control layer or substrate layer that "wets out" the desk surface, in much the same fashion as non-adhesive vinyl decals are adhered to a surface. Useful highly plasticized, non-adhesive layers may comprise a plasticized rubber such as neoprene. It is most preferred to utilize a repositionable adhesive, such as that known under the trade designation "Post-It", which is described in the previously mentioned '731 patent.

Alternatively, the control layer may have applied on its back surface a "slidable" pressure-sensitive adhesive such as those described in U.S. Pat. No. 5,141,790, incorporated by reference herein. This allows the inventive articles to be moved into place and then adhered by hand pressure. The adhesives described in the '790 patent comprise a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive. Preferably, the individual particles are smaller than the thickness of the pressure-sensitive adhesive layer, and substantially every clump extends to a height above the surface of the pressure sensitive adhesive layer that exceeds the average size of the particles. The particles are preferably microspheres of adhesive such as those described in U.S. Pat. No. 3,691,140, further described herein below.

The control surface of the invention may be tailored (by proper combination of microstructure, composition and transparency) so that the array of precisely shaped protrusions and recesses defining the control surface creates an optical effect, such as Moire patterning or "image shifting." That is, the image changes with viewing angle.

In another of its embodiments, the invention relates to an article comprising a control layer having a control surface and a back surface, the control surface comprising an array of precisely shaped protrusions in the form of posts having bases in the plane of the control layer. In one embodiment the posts have non-planar sides which taper radially inwardly from their bases to their tops, the posts preferably comprising cones or conical frustums which have substantially circular bases. In another embodiment, the posts are essentially right cylinders of constant diameter from their base to their tops. This latter arrangement produces a matte surface texture comprised of a great number of plateau-like protrusions scattered at random on the surface and each having a top at the same level.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective schematic view of a computer work station including a mouse and mouse pad;

FIG. **1***a* is a plan view of a portion of the control surface of an illustrative mouse pad of the invention;

FIGS. **2***a*–**2***f* are cross-section views taken along the section **2***a*–**2***a* as shown in FIG. **1**;

FIGS. **3***a*–**3***c* are cross-section views of kit embodiments of the articles of the invention;

FIG. **4** is a cross-section view of another kit embodiment of the invention;

FIGS. **5** and **6** illustrate in cross-section other alternatives to the embodiment shown in FIG. **2***d*;

FIG. **7** illustrates an embodiment which is an alternative to the embodiment illustrated in FIG. **3***a*;

FIG. **8** is a cross-section of an alternative to the embodiment illustrated in FIG. **4**; and

FIG. **9** is a cross-section of an alternative embodiment showing a different microstructured surface.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** illustrates in perspective schematic a mouse pad **1** having a control surface **2**, mouse pad **1** lying essentially horizontally on a table or desk **3** having a top surface **5**. A mouse **7** is shown resting on control surface **2**, mouse **7** having wire **9** connecting it to a computer **11**.

FIG. **1***a* is an illustrative embodiment of a preferred control surface **2** of the mouse pad of the invention. A pattern of three intersecting sets of parallel v-shaped grooves yields the structured control surface **2**. The apexes of each set of grooves are identified as a, b, and c. The base of each individual protrusion **22** is defined by one groove of each of the three sets. As mentioned above, the three sides of the base of each three-sided pyramid are typically relatively equal in length. This can be controlled by selection of the intersection angles between the three sets of grooves, i.e., alpha, beta, and gamma. Each side of the base of a pyramidal protrusion and the peak of that protrusion defines a plane, referred to herein as a face of the protrusion. The faces of each protrusion are preferably relatively equal in area.

The direction parallel to each set of grooves is referred to herein as a major axis of the control surface. Thus, the article illustrated in FIG. **1***a* has three major axes. The maximum grip or friction provided by control surfaces of this type is obtained in a direction perpendicular to one of the major axes of the control surface. In some instances, articles of the invention are characterized as having directional gripping characteristics.

In a second embodiment of the invention (not illustrated), the protrusions comprise posts having non-planar sides and bases on the control layer. The posts taper radially inwardly from their bases to their tops. Preferably, the posts comprise substantially circular bases and the posts are either cones or conical frustums. Most preferably, land areas separate adjacent ones of the bases of the posts.

With respect to articles of the invention in general, if the protrusions comprise pyramidal or conical frustums, each frustum typically has a planar top or upper surface which is parallel to its base, although it is contemplated that the planar top or upper surface of the frustum can be inclined at an angle relative to the frustum's base. Further, the tops or upper surfaces of the frustums are not necessarily planar.

If the control surface of an article of the invention is defined by pyramids or cones, it is typically preferred, but not essential, that the peak of the pyramid or cone be centered over the geometric center of the base of the pyramid or cone. If the control surface of the article is defined by pyramidal or conical frustums, it is preferred, but not essential, that the planar tops of the frustums have geometric centers which are centered over the geometric centers of their respective bases. In some instances, if the protrusions of a control layer have peaks or planar tops which are "horizontally offset" from their respective bases, the sheeting may have directional gripping characteristics as a result. Articles having directional gripping characteristics would likely be considered desirable in many envisioned applications.

With respect to any embodiment of the invention, the protrusions are typically between about 3 mils and about 21 mils (75 and 525 micrometers), preferably between about 5 mils and 9 mils (125 and 225 micrometers), and most preferably about 7 mils (175 micrometers), in height. In some embodiments, the control layer can comprise protrusions up to about 30 mils (750 micrometers) in height, although such control layers may tend to be abrasive to one's skin. As used herein and illustrated in FIG. **2***a*, the height h of a protrusion refers to the length of the shortest possible line segment extending from the protrusion's peak P to its base. The protrusion's peak is defined to be the highest point of the protrusion, i.e., the point of the protrusion located furthest from the plane in which the base of the protrusion lies.

The shape of a protrusion is characterized by its aspect ratio, which is defined as the ratio of the protrusion's height h to its equivalent base diameter D_{eq}. Where the base of the protrusion is a circle, the equivalent base diameter D_{eq} is simply the diameter of the circle. Where the base of the protrusion is not a circle, the equivalent base diameter D_{eq} is defined as the diameter of a hypothetical circle having the same area as the base. It is believed that the invention can be practiced satisfactorily if the protrusions have an aspect ratio which is from about 0.1 to about 5. Most preferably, the aspect ratio for pyramidal protrusions is from about 0.3 to about 0.6, and the aspect ratio for protrusions which are tapered posts is about 2.

Referring to FIG. **2***d*, layers **15** and **19** typically comprises a polymeric film selected from, for example, the group consisting of polyvinyls, polyurethanes, polyesters, e.g., polyethylene terephthalate, polyacrylics, polycarbonates, polyolefins, and mixtures thereof. Polyurethanes are presently preferred because they typically yield control surfaces which offer an optimum combination of high toughness and durability coupled with high softness and flexibility. Polyacrylics typically yield articles that are relatively rigid.

Control layer **19**, excluding the height of the protrusions, is typically between about 2 mils and about 100 mils (50 and 2,500 micrometers) thick, and most preferably between about 4 mils and about 20 mils (100 and 500 micrometers) thick.

FIGS. **2***a*–**2***f* illustrates article embodiments **10**, **20**, **30**, **40**, **50** and **60**, respectively, in cross-section along the line **2***a*–**2***a* of FIG. **1**. Embodiment **10** (FIG. **2***a*) comprises a removable and rebondable adhesive layer **13** to which at least one major surface is adhered to a plastic layer **15**, which in turn has another adhesive layer **17** adhered over the plastic layer **15**.

A suitable removable and rebondable adhesive is available from Minnesota Mining and Manufacturing Company, St. Paul, Minn. ("3M") under the trade designation "Post-It", which comprises inherently tacky elastomeric acrylate copolymer microspheres as disclosed in claimed in commonly assigned U.S. Pat. Nos. 3,691,140, and 3,857,731, both incorporated herein by reference. The '140 patent teaches that the copolymer microspheres disperse in various solvents to form suspensions which can be utilized in aerosol spray applications. When a substrate is sprayed on such suspensions and the solvent thereafter evaporated, there results a continuous coating of mildly tacky pressure-sensitive adhesive. Paper and the like can be applied to the surface of the coating, removed, repositioned, and rebonded. It had been found, however, that during removal of an adhered object, some of the particular adhesive spheres would transfer to the surface of the object, reducing the number of spheres on the originally coated substrate. Therefore, a substrate having the adhesive sprayed thereon would soon lose its tacky nature, and after repeated applications and removals, subsequent objects would eventually not adhere thereto. The invention of the '731 patent solved this problem by providing individual sockets on a substrate surface with a microspherical adhesive to be retained in, thereby reducing or eliminating transfer of the microspheri-

cal adhesive upon removal of an object adhered thereto. The individual sockets are conveniently provided by a binder material bonded to the substrate surface.

In accordance with the present invention, adhesive layer **13** preferably comprises a binder material having embedded therein and protruding from the exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres of the type disclosed and claimed in the '140 patent. These microspheres consist essentially of about 90 to 99.5 percent by weight of at least one acyl acrylate ester and about 10 to about 0.5 weight percent of at least one monomer selected from the group consisting of substantially oil-insoluble, water-soluble, ionic monomers and maleic anhydride. The normally tacky and elastomeric copolymer spheres are small in size, having diameters in the range of about 1 to 250 micrometers, with the majority of the spheres falling in the range of about 5 to about 150 micrometers.

The binder compound utilized to anchor the spheres to prevent the removal from the adhesive surface should be compatible with the microspheres and the table or desktop **5** illustrated in FIG. **1**, i.e., it should neither chemically attack the polymer spheres or tabletop **5** nor act as a solvent for them. In other words, the anchoring binder should be inert toward the microspheres and the surface to which the article of the invention is applied. The film-forming resins having a high degree of adhesion for the acrylate copolymer spheres generally are effective to anchor the spheres to a substrate. Relatively hard resins such as epoxies and nitrocellulose and relatively soft resins such as acrylates and vinyl ethers are examples of suitable film-forming anchoring binder resins.

As explained in the '731 patent, where necessary, conventional primers can be conveniently utilized between adhesive layer **13** and plastic layer **15**. The art of priming substrates to allow wetting or bonding of a variety of coatings is well known, such as disclosed in U.S. Pat. Nos. 2,328,066 and 2,926,105, which disclose primers for cellophane plastic materials, U.S. Pat. No. 2,927,868, which discloses primers for acetate films, and U.S. Pat. No. 2,897,960 which discloses primers for polyvinylchloride films, all of which are incorporated by reference herein.

Application of adhesive layer **13** to plastic layer **15** can be undertaken in any conventional manner. For example, the mixture may be coated to a desired thickness, using, for example, a knife, a wire-wound bar or a rotogravure roll. Alternatively, the mixture may be sprayed onto the plastic **15**.

Although all the embodiments shown in FIGS. **2***a*–**2***f*, illustrate adhesive layer **13** across the entire surface of plastic **15**, it will be appreciated that one advantage of the articles of the invention is that the articles may be made with adhesive **13** present only around the perimeter of the article. This would allow the placement of photographs or other preprinted sheets to be placed under the control layer **19**.

Of course it is within the invention that the articles of the invention may be adhered "permanently" to desk or tabletop **5**. In these embodiments, adhesive **13** may be any of those commercially available adhesives described in assignees copending patent application Ser. No. 07/929,685, which was cross-referenced above. Suitable permanent adhesives are also discussed below.

Plastic sheet **15** as shown in FIGS. **2***a*–**2***c*, as well as in FIGS. **3***a*–**3***c*, **5**, **7**, and **9**, may actually be plastic or paper. When layer **15** is paper, layers **13** and **15** may comprise a single product such as that known under the trade designation "3M Laser Label" sheets, number 7701, which are available in 8.5 by 11 inch sheets suitable for use with a personal computer printer such as the printers known under the trade designations "HP Deskjet 500C" and "HP LaserJet IIIp", both available from Hewlett Packard Corporation, Palo Alto, Calif. Laser label sheets having a model number 7701 comprise a cellulose paper layer **15** having an adhesive layer **13** thereon, the adhesive layer **13** in turn having a release liner **25** (FIGS. **3** and **4**). The advantage of these such laser label sheets will become apparent with a description of the embodiments in FIGS. **3** and **4**.

Referring again to embodiment **10** illustrated in FIG. **2***a*, adhesive layer **17** is a permanent adhesive, such as those described above applicable for use for adhesive layer **13**. Adhesive for use in adhesive layer **17** should be inert to layer **15** and layer **19**, i.e., adhesive **17** should not chemically attack the materials of layers **15** and **19**.

Control layer **19** as illustrated in FIGS. **2***a*–**2***f* has a control surface **2** which is a microstructured surface consisting of tiny pyramids [approx. 0.01 to 0.014 inches (about 2.54×10^{-3} to about 3.56×10^{-2} cm) in height]. This microstructured surface gives a precise functional control surface **2** which is uniform in texture which affords good aggressive grab to a mouse tracking ball, but which is preferably not abrasive to the user's hand. A control surface preferably provides a smooth uniform and predictable movement to the pointer or cursor on the computer screen. The plastic material which comprises control layer **19** is preferably transparent and colorless allowing any printing which appears on plastic surface **15** (such as represented by ink layer **21** and FIGS. **2***b* and **2***c*) to be seen. Alternatively, pigments and/or dyes may be incorporated into control layer **19** to create a marbled appearance, or a colored opaque appearance.

Ink **21** is preferably any ink or pigment which may printed by typical personal computer printers, and which will adhere to paper or film layer **15**. As illustrated in FIGS. **2***b* and **2***c*, ink layer **21** may either be positioned at the entire cross-section of the article as illustrated in FIG. **2***b*, or there may be areas devoid of ink such as illustrated in FIG. **2***c*, as when words or other characters are printed on layer **15**.

FIGS. **2***d*–**2***f* illustrate alternative embodiments **40**, **50**, and **60** to those illustrated in **2***a*–**2***c*, respectively. Embodiment **40** illustrated in FIG. **2***d* consists simply of adhesive **13** (preferably removable and rebondable) adhered to bottom surface of control layer **19**. FIGS. **2***e* and **2***f* illustrate embodiments similar to that illustrated in FIG. **2***d*, with the inclusion of ink layer **21** printed or adhered to the noncontrol surface, as explained previously.

FIGS. **3** and **4** illustrate kit embodiments of the present invention. For example, embodiment **70** is represented by two sheet-like materials, the first sheet-like material comprised of an adhesive layer **17** having a release liner **23** attached thereto, the adhesive in turn attached to control layer **19**. A second sheet-like material of the kit of FIG. **3***a* comprises an adhesive layer **13** (preferably a rebondable adhesive) having a release liner **25**, the adhesive layer **13** to attached to paper or plastic film layer **15**. In embodiment **70** of FIG. **3***a*, the sheet-like portion consisting of layers **13**, **15** and **25** is available under the trade designation "3M Laser Label" sheets, model no. 7701, which are the 8.5 by 11 inch sheets previously mentioned. Adhesive layer **17** is typically and preferably a permanent adhesive known under the trade designation "3M Adhesive Transfer Tape 950" from 3M, which is an acrylate-based permanent adhesive.

Kit embodiments **70'** and **70"** as shown in FIGS. **3***b* and **3***c*, respectively, are similar to kit embodiment **70** of FIG. **3***a* except for the provision of ink layers **21** as previously mentioned.

The kits of FIGS. 3*a*–3*c* are especially useful for users having personal computers and printers. These kits allow the user to print on the surface **15** as shown in FIGS. 3*b* and 3*c* by inserting laser label sheets such as those described above into the paper holder of a printer. Essentially any information that can be typed or graphically shown on the computer screen can be printed on the layer **15** such as important, frequently called telephone numbers, advertising logos, designs, and the like.

Referring now to FIG. **4**, embodiment **80** illustrated is another two-piece kit. However, the first sheet member of the kit is simply a control layer **19** having a control surface **2**, while the second sheet member consists of an adhesive layer **13** (preferably a repositionable adhesive) having on its major surfaces release liners **23** and **25**.

Release lining materials can be of any material which does not adhere permanently to the adhesive. Suitable release materials include paper or polyesters which have been treated with a non-adhering substance such as a neat silicone or a fluorocarbon. Alternatively, the release material may be a suspension emulsion, or dispersion of a silicone- or a fluorocarbon-based substance applied directly to the adhesive layer by any method including spraying. Silicone-treated paper is commercially available from James River Corporation (Parchment, Mich.) and a silicone-based emulsion for spray applications is commercially available from Paper-chem Labs (Rockhill, N.C.).

If layer **15** in any embodiment is plastic, suitable materials include those useful in forming the control layer **19**, including polyester, polyvinyl chloride, polystyrene, polypropylene, polyethylene, polybutylene, copolymers of polyethylene and vinyl acetate, cellulose di- and triacetate, and ethyl cellulose. One useful polyester film commercially available is that known under the trade designation "Mylar" from E. I. DuPont de Nemours & Company, Wilmington, Del.

As stated previously, it is possible to repositionably adhere the control layer **19** in all embodiments directly onto the desk or other surface by use of a highly plasticized control layer **19**. Suitable plasticizers for this purpose include both so-called "internal" and "external" plasticizers, the former meaning a copolymer of a monomer of low T_g, the latter meaning a compound not chemically bound to the polymer. Polyvinyl chloride is a preferred polymer for use in plastic layers since it is compatible with a variety of plasticizers and because the plasticized polymer remains quite stable physically and chemically for long periods of time. Cost, odor and other factors may be important in selecting the plasticizer. Suitable external plasticizers for polyvinyl chloride include tritolyl phosphate, dinonyl phthalate, dioctyl sebacate, dioctyl phthalate, and di-2-ethylhexyl phthalate. Dimethyl phthalate is typically used to plasticize cellulose acetate. External plasticizers may be incorporated into the polymer at a weight percentage ranging from 1 to about 50 weight percent.

Referring now to FIGS. **5–8**, therein illustrated are constructions **90**, **100**, **110** and **120**, which are alternatives to embodiments of **10**, **10**, **70**, and **80**, respectively. In FIGS. **5–8**, adhesive layer **13** of embodiments **10**, **70** and **80** is replaced by a three layer structure consisting of an adhesive layer **27** which adheres plastic or paper layer **29** to plastic or paper layer **15**, and another adhesive layer **31**, which as above described may either be a permanent adhesive or a repositionable adhesive, preferably the latter.

Illustrated in FIG. **9** is embodiment **130**, an alternative of embodiment **10** illustrated in FIG. **2***a*. Embodiment **130** illustrated in FIG. **9** differs by having a different control surface **2** formed in the control layer **19**. The control surface **2** illustrated in FIG. **9** is commonly referred to as a continuous, uniform random texture, and is described generally in U.S. Pat. No. 4,799,054. The '054 patent describes this surface as a matte surface texture comprised of a great number of plateau-like protrusions scattered at random on the surface and each having a top at the same level. The spaces between the protrusions must be small compared to the surface area of the tracking ball which contacts the control surface **2**. A suitable material for use as this surface is a polyvinyl chloride, available from Goss Plastics Film Corporation of Los Angeles, Calif., under the trade designation "Goss 48.4". This product is scratch-resistant and is available in thickness ranging from about 10 to 20 mils (2.54×10^{-2} to 5.08×10^{-2} cm).

Other materials which may be used for control layer **19** include those mentioned in the '054 patent including a textured polycarbonate material available from General Electric Company of Pittsfield, Mass., under the trademark "Lexan", or from any of Mobil Chemical Corporation, Plastics Division, of Pittsburgh, Pa., Rohm and Haas Company of Philadelphia, Pa., and Humko Shefield Chemical of Memphis, Tenn. Polystyrene, polyester, or acetate films may also be used as well as urethane as previously discussed.

Control layer **19** preferably has hardness ranging from about 70 durometer to about 140 durometer, measured on the Shore "A" durometer scale. Such measurements should be made using an apparatus substantially meeting the American Society for Testing and Materials Standard D 2240-68.

It may also be beneficial to provide the articles of the invention with antistatic properties. A simple wire attachment may utilized for this purpose. Antistatic agents or conductivity enhancers may be applied to the surface of the finished article or incorporated into the bulk of the plastic polymer (when polymeric layers are employed). The main groups of useful and preferred antistatic agents include ionic compounds, such as quaternary ammonium salts and amines and hydrophilic compounds such as polyglycols and ethylene oxide derivatives. These antistats increase the electrical conductivity of the material by increasing its surface ionic activity. Other useful but less preferred methods may be used, such as incorporation of small amounts of electrically conductive metallic staple fibers, or certain types of carbon black, into the polymer layer(s).

Antistatic agents applied by surface treatment may be applied to plastic polymer layers by dipping, wiping, or spraying a solution or dispersion of the antistat in water or other inexpensive, volatile solvent.

Internal antistatic agents are incorporated into the bulk of the polymer from where it gradually migrates to the surface. Preferred are those internal antistatic agents which are reasonably compatible with the polymer, diffuses through the polymer adequately, and has thermal stability suitable for the end use of the article. The antistatic agent also should not cause undesirable side effects on the article.

The type and amount of internal antistatic agent incorporated into a polymer layer depends greatly on the composition of the polymer. Nonionic ethoxylated compounds are preferred for polyvinyl chloride; N-alkyl diethanolamines are preferred for polyolefins; and quaternary ammonium compounds are preferred for polyurethanes. The amount of internal antistatic agent generally ranges from about 0.05 weight percent to about 5 weight percent, based on total weight of polymer and antistatic agent. A more comprehensive list of both external and internal antistatic agents and there selected use in various polymer systems is available in

Kirk-Othmer, *Encyclopedia of Chemical Technology*, 3rd Edition, Vol. 3, pp. 149–183, John Wiley & Sons (New York, 1978), which is incorporated herein by reference.

The control layer may also have a water and oil repellant and soil resistant coating thereon (or added to the polymer melt composition of the control layer prior to formation of the control layer). Suitable coatings include those commonly employed in fabric and carpet treatment, such as various fluorinated compounds. The fluorinated compounds may be incorporated in most conventional plastics either by copolymerization of reactive fluorinated intermediates or by the inclusion of fluorinated compounds as additives.

Fluorinated intermediates can generally be represented by the formula R_f—X—Y, wherein R_f is a fluoroaliphatic group, X is a divalent linking group, typically a hydrocarbon, between the fluoroaliphatic group and a reactive functional group Y.

Typical examples of reactive intermediates useful in the present invention include alcohols, which can react with isocyanate groups in forming the preferred polyurethane control layers. Useful alcohols include $F(CF_2)_8$—CH_2—CH_2OH and $F(CF_2)_8$—SO_2—NR—CH_2—CH_2OH, and others disclosed in U.S. Pat. No. 4,264,484 (incorporated by reference herein). Vinyl-functional compounds, such as $F(CF_2)_8$—CH_2—CH_2—O—C(O)—CH=CH_2, may be useful in acrylic films. Other useful functional groups on fluoromonomers include acrylates, epoxides, diols, diamines, diacids, and functional silanes. Other useful fluorinated compositions are the blends disclosed in U.S. Pat. Nos. 4,560,487 and 4,681,790, both of which are incorporated by reference herein. Reactive fluorinated intermediates, when incorporated either as comonomers in polymeric systems or as additives, influence the surface properties of the plastic control surface. A useful range, depending on the particular degree of repellency desired, is from about 5 to 70% by weight of a fluorinated monomer.

Alternatively, partially fluorinated, low molecular weight substances may be included as additives to conventional hydrocarbon polymers during melt extrusion. The fluorinated additives migrate to the surface at rates that depend generally on the melt viscosity of the bulk plastic. As little as 0.01 weight percent of a low molecular weight copolymer of perfluoroalkylethyl methacrylate and acrylamide (85/15) significantly lowers the surface tension of an acrylic polymer film. Similar effects are seen by using perfluorosulfonic acids in polycarbonates, and perfluoroalkylethyl stearates in high density polyethylene. Generally about 0.1 to 1.0% by weight of the fluorinated additive is employed.

Since proper operation of a personal computer mouse relies on the rotational movement of the tracking member maintaining a constant relationship with a linear movement of the mouse itself, it is important that control surface **2** be provided with some texture, as mouse track balls may themselves be provided with smooth surfaces. Selecting a material of proper texture for the control layer **19** can, therefore, usually increase the frictional engagement between the track ball and the control surface **2**. Also, the inclusion of a texture on control surface **2** provides even better operation with a mouse having a track ball including a rubber-like outer surface. This frictional engagement facilitates maintaining a 1:1 relationship between the linear mouse movement and track ball rotation.

As alluded to in the discussion of application of graphic symbols to the articles of invention using inks **21** applied to a substrate member (see FIGS. **2***b*, **2***c*, **3***b* and **3***c*) it is also possible to apply graphic symbols such as by the application of ink, to the back side of control layer **19** not having the control surface **2**, as illustrated in FIGS. **2***e* and **2***f*. In all embodiments of the invention, difficulties can thus be avoided that arise as to the information being worn off or interfering with the operation of track ball when the information is printed directly on control surface **2**. Ink jet printers can be used to print directly onto the control surface, but this is not preferred.

Control surface **2** is defined by an array (i.e., an orderly arrangement such as a regularly repeating pattern) of precisely shaped protrusions thereon. Protrusions may be discrete elements laminated to control layer **19** or may be integral parts of control layer **19**, i.e., control layer **19** may be structured in the form of protrusions **22**.

In preferred embodiments of the invention, protrusions on control surface **2** comprise pyramidal protrusions, i.e., pyramids with polygonal bases or pyramidal frustums with polygonal bases. Each polygonal base is disposed on a first surface of control layer **19** and is defined by a plurality of line segments which lie in or on the plane of the control layer.

The polygonal bases of the protrusions are preferably selected from the group consisting of triangular bases, quadrilateral bases, pentagonal bases, hexagonal bases, heptagonal bases, octagonal bases, nonagonal bases and decagonal bases. In a most preferred embodiment, as illustrated in all FIGS. except FIG. **9**, the protrusions are triangular pyramids, i.e., three-sided pyramids having triangular bases. The polygonal bases of the protrusions are typically immediately adjacent one another such that there is no land separating the polygonal bases.

The line segments defining the sides of the polygonal base of each pyramidal protrusion are preferably relatively equal in length, but need not be. By relatively equal, it is meant that the length of the shortest line segment is equal to at least about 50 percent of the length of the longest line segment. Most preferably, the line segments defining the sides of the polygonal base of each pyramidal protrusion are equal in length. Each line segment is typically between about 5 and about 75 mils (125 and 1,875 micrometers), but preferably is between about 5 and about 30 mils (125 and 750 micrometers), and most preferably between about 10 and about 20 mils (250 and 500 micrometers), in length.

As previously stated, referring again to FIGS. **3** and **4**, the sheeting of the invention can include optional release liners and optional permanent adhesive layers. Permanent adhesive layers typically comprise an adhesive selected to provide a strong bond to the substrate article to which the resultant sheeting is to be applied. For example, heat-activated adhesives, pressure-sensitive adhesives, and mixtures thereof can be used. An illustrative example of a useful adhesive is that known under the trade designation "3M Adhesive Transfer Tape 950" from Minnesota Mining and Manufacturing Company. Many suitable epoxy, urethane, and acrylic adhesives are commercially available.

In some instances, the protrusions of the control surface may be made of a first, relatively hard and highly durable material, and the control layer **19** may be made of a relatively more flexible material. Further, the material of the protrusions can comprise an abrasive or other filler. Further, all or a portion of each protrusion can be filled with a fluid, e.g., a gas such as air or nitrogen. If a gas were used, the pressure of the gas within each protrusion would have to be selected to provide the protrusions with the desired amount of compressibility.

Properly constructed articles of the invention generally exhibit a combination of high durability and friction due to

the coupling of hard protrusions (e.g., polycarbonate), which are typically substantially incompressible and non-collapsible, with a more conformable, flexible material (e.g., polyurethane) that results in a more cushioned impact during use.

The control layer of some embodiments of articles of the invention can be made using techniques which are somewhat similar to those used to make cube-corner retroreflective sheetings. It will be understood, however, that the control layer is preferably transparent, and can be made in a variety of transparent colors if desired. For example, referring to FIG. 2*a*, control layer **19** can be made such that it will retroreflect less than about 10 percent of a beam of electromagnetic radiation which is incident at any angle to control surface **2**, the electromagnetic radiation having any wavelength within the visible light or infrared radiation regions, i.e., wavelengths ranging from about 0.39 micrometers to about 1,000 micrometers. Thus, at least a portion of control layer **19** can have a structure similar to retroreflective sheetings, but need not be retroreflective. This means that control layer **19** can be made of less expensive materials because optical performance is not a concern. Further, control layer **19** need not necessarily be manufactured in as precise a manner as retroreflective sheetings since optical performance is not needed.

A control layer **19** useful in the invention may be formed by cutting a series of v-shaped grooves into a solid sheeting, molding a sheeting with the desired precisely shaped protrusions thereon, or molding precisely shaped protrusions and then applying them to a desired backing sheet. Many of the techniques used for fabricating cube-corner retroreflective sheeting may be used to form the control layers useful in the invention, with the important advantage that the optical properties critical to retroreflective sheetings are not necessary for sheets of the invention. U.S. Pat. No. 4,576,850 (Martens), which is incorporated in its entirety herein by reference, discloses a process for replicating microstructured surfaces that may be used in making sheetings of the invention. U.S. Pat. No. 3,689,346 (Rowland) also discloses a method comprising applying a hardenable molding material over a mold having a multiplicity of cube-corner formations therein.

Desired flexibility, elasticity, and conformability of the inventive article is dependent in part upon the desk or other surface to which it is to be applied. It is preferred that the repositionable article be somewhat elastic and conformable so as to give or compress under pressure of a track ball when the article is used as a mouse pad. During use, it is possible that the table or surface may be flexible, such as when the mouse pad of the invention is placed over a conventional "foam-backed" mouse pad. Accordingly, a mouse pad of the invention for use thereon should be flexible, as described above.

In general, an article of the invention useful as a mouse pad can be repositionably secured to any surface over which the mouse traverses.

Other modifications and uses of the articles of the invention will become apparent to those skilled in the art. The articles of the invention may be of use in airplanes as covers for pull-down trays, or as coasters for drink containers. The control surface may have thereon a coating such that it will receive indicia, such as a 95/5 weight ratio coating of methyl methacrylate/N-vinyl pyrrolidone copolymer such as those coatings typically applied to the face of overhead transparencies. The article may be formed to contain a pocket such that photos or artwork can be inserted therein, or folding lines may be formed into the article such that it forms a flap wherein art or photos can be contained. These modifications and alterations of the invention are considered within the scope of the following claims.

What is claimed is:

1. A repositionable article having a microstructured surface comprising:

a) a removable and rebondable adhesive layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the second surface of the adhesive layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

2. Article in accordance with claim **1**, wherein said adhesive layer comprises a rebondable adhesive exhibiting a peel adhesion ranging from about 22 to about 275 grams per cm.

3. Article in accordance with claim **1**, wherein said adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

4. Article in accordance with claim **1**, wherein said control layer is transparent.

5. Article in accordance with claim **1**, wherein said control layer consists essentially of a polymeric organic material.

6. Article in accordance with claim **1** having a graphic representation positioned between the adhesive layer and control layer.

7. Article in accordance with claim **1** having a graphic representation positioned on the control surface.

8. Article in accordance with claim **1** having an antistatic agent dispersed in the control layer.

9. Article in accordance with claim **1** having an antistatic agent coated onto the control surface.

10. Article in accordance with claim **1** having a fluorochemical dispersed in the control layer.

11. Article in accordance with claim **1** having an fluorochemical coated onto the control surface.

12. Article in accordance with claim **1** having a copolymer coating on the control surface, the copolymer comprising about 95 weight percent of polymerized methyl methacrylate units and about 5 weight percent polymerized N-vinyl pyrrolidone units.

13. Article in accordance with claim **1** wherein said adhesive comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

14. A repositionable article having a microstructured surface comprising:

a) a removable and rebondable first adhesive layer having first and second surfaces;

b) a substrate layer having first and second surfaces, the second surface of the first adhesive layer adhered to the first surface of the substrate layer;

c) a second adhesive layer having first and second surfaces, the first surface of the second adhesive layer adhered to the second surface of the substrate layer; and

d) a control layer having a control surface and a back surface, the back surface adhered to the second surface of the second adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

15. Article in accordance with claim 14 wherein said substrate layer is selected from a group consisting of plastic and paper.

16. Article in accordance with claim 14 wherein said first adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

17. Article in accordance with claim 14 wherein said first adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

18. Article in accordance with claim 14, wherein said second adhesive layer is a permanent adhesive.

19. Article in accordance with claim 14, wherein said control surface consists of a uniform array of a plurality of pyramids having a height ranging from about 2.54×10^{-3} cm to about 0.1 cm.

20. Article in accordance with claim 14 wherein said substrate layer is a foamed material.

21. Article in accordance with claim 14, wherein said control layer is transparent.

22. Article in accordance with claim 21, wherein said substrate layer has between its second surface and the first surface of said second adhesive a graphic design adhered therebetween.

23. Article in accordance with claim 14, wherein said first adhesive layer has a peel adhesion ranging from about 22 to about 275 grams per cm.

24. A kit for use in producing a repositionable sheet member, the kit comprising:

a) a first sheet member consisting of:

1) a first release liner material having first and second surfaces;

2) a first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release liner material; and

3) a control layer having a control surface and a back surface, the back surface of the control layer adhered permanently to the first surface of the first adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions; and

b) a second sheet material consisting of:

1) a second release liner material having first and second surfaces;

2) a removable and rebondable second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the second release liner material; and

3) a substrate layer having first and second surfaces, the second surface of the substrate layer adhered to the first surface of the second adhesive layer, and the first surface of the substrate layer adapted to be permanently adhered to the first surface of the first adhesive layer when the first release material is removed from the first adhesive layer and the first adhesive layer and substrate layer are joined.

25. Kit in accordance with claim 24 wherein said second adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

26. Kit in accordance with claim 24 wherein said second adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

27. Kit in accordance with claim 24 further comprising a graphic layer, the graphic layer positioned either between the first adhesive layer and the control layer, or adhered to the second surface of the substrate layer.

28. A kit adapted to be manipulated by the user into a repositionable article having a microstructured surface, comprising:

a) a first sheet material having a control surface and a back surface, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions; and

b) a second sheet material comprising:

1) a first release material having first and second surfaces;

2) a removable and rebondable adhesive layer adapted to be attached to the back surface of the control layer, the adhesive layer having first and second surfaces, the second surface of the adhesive layer removably adhered to the first surface of the first release material; and

3) a second release material having first and second surfaces, the second surface of the second release material removably adhered to the first surface of the adhesive layer.

29. Kit in accordance with claim 28 wherein said adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

30. Kit in accordance with claim 28 wherein said adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

31. A repositionable article having a microstructured surface comprising:

a) a removable and rebondable first adhesive layer having first and second surfaces;

b) a first substrate material having first and second surfaces, the second surface of the first substrate material adhered to the first surface of the first adhesive layer;

c) a second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the first substrate layer;

d) a second substrate layer having first and second surfaces, the second surface of the second substrate layer adhered to the first surface of the second adhesive layer;

e) a third adhesive layer having first and second surfaces, the second surface of the third adhesive layer adhered to the first surface of the second substrate material; and

f) a control layer having a control surface and back surface, the back surface of the control layer adhered to the first surface of the third adhesive layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

32. Kit in accordance with claim 31 wherein said first adhesive layer comprises a binder material having embed-

ded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

33. Kit in accordance with claim 31 wherein said first adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

34. Kit in accordance with claim 31 wherein said control layer is transparent.

35. Kit in accordance with claim 31 wherein a graphics layer lies in between said second substrate layer and said third adhesive layer.

36. A kit including first and second sheet-like articles, the kit comprising;

a) the first sheet-like article consisting of:

1) a first release material having first and second surfaces;

2) a first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release layer; and

3) a control layer having a control surface and a back surface, the back surface adhered to the first surface of the first adhesive layer, the control layer defined as above; and

b) said second sheet-like article consisting of:

1) a second release material having first and second surfaces;

2) a removable and rebondable second adhesive layer having first and second surfaces, the second surface of the second adhesive layer removably adhered to the first surface of the second release material;

3) a first substrate layer having first and second surfaces, the second surface of the first substrate layer adhered to the first surface of the second adhesive layer;

4) a third adhesive layer having first and second surfaces, the second surface of a third adhesive layer adhered to the first surface of the first substrate layer; and

5) a second substrate layer having first and second surfaces, the second surface of the second substrate layer adhered to the first surface of the third adhesive layer.

37. Kit in accordance with claim 36 wherein said second adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

38. Kit in accordance with claim 36 wherein said second adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

39. Kit in accordance with claim 36, wherein said control layer is transparent.

40. Article in accordance with claim 36 which further comprises a graphics layer adhered to the first surface of the second substrate.

41. A kit including first and second sheet-like articles comprises;

a) a first sheet-like article consisting of a control layer having a control surface and a back surface, the back surface adapted to be contacted with a second sheet-like article, the control surface defined as above; and

b) a second sheet-like material consisting of:

1) a first release material having first and second surfaces;

2) a removable and rebondable first adhesive layer having first and second surfaces, the second surface of the first adhesive layer removably adhered to the first surface of the first release material;

3) a substrate layer having first and second surfaces, the second surface of the substrate layer adhered to the first surface of the first adhesive layer;

4) a second adhesive layer having first and second surfaces, the second surface of the second adhesive layer adhered to the first surface of the substrate layer; and

5) a second release material having first and second surfaces, the second surface of the second release material removably adhered to the first surface of the second adhesive layer, the second release material and the first release material adapted to be removed from the second sheet-like article, and the first surface of the second adhesive layer adapted to be adhered to the second surface of the control layer.

42. Kit in accordance with claim 41 wherein said first adhesive layer comprises a binder material having embedded therein and protruding from an exposed surface thereof, elastomeric, inherently tacky, acrylate copolymer microspheres.

43. Kit in accordance with claim 41 wherein said first adhesive layer comprises a pressure-sensitive adhesive layer comprising a plurality of spaced clumps of particles substantially uniformly distributed over and protruding from one face of the pressure-sensitive adhesive layer, the tips of the clumps of particles being substantially free from the pressure-sensitive adhesive.

44. A support article from which sheet-like pressure sensitive adhesive-backed articles can be removed, the article comprising a plurality of repositionable articles each having a microstructured surface, each repositionable article comprising:

a) a removable and rebondable adhesive layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the second surface of the adhesive layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions,

the repositionable articles being relatively disposed so that at least a portion of the control surface contacts at least a portion of the first surface of the adhesive layer of an underlying repositionable article.

45. The support article of claim 44 wherein the repositionable articles are disposed in the form of a stack.

46. The support article of claim 44 wherein the repositionable articles are disposed in the form of a roll.

47. The support article of claim 44 further comprising a support member upon which is mounted one or more of said repositionable articles.

48. A repositionable article having a microstructured surface comprising:

a) a non-adhesive, high friction layer having first and second surfaces;

b) a control layer having a control surface and a back surface, the second surface of the non-adhesive, high friction layer adhered to the back surface of the control layer, the control surface defined by an array of a plurality of precisely shaped raised regions and a plurality of recessed regions.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.: 5,508,084

DATED: April 16, 1996

INVENTOR(S): Reeves et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 12, line 43, Delete "2fillustrate" and insert --2f illustrate--

Signed and Sealed this

Eleventh Day of February, 1997

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

ATTORNEY DOCKET NO. 5923.0001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	Goecke
TITLE	:	Adhesive Tape
SERIAL NO.	:	10/674,108
FILING DATE	:	September 29, 2003
ART UNIT	:	1788
CONFIRMATION NO.	:	2438
ATTORNEY DOCKET NO.	:	5923.0001

Exhibit G

Hornibrook U.S. Patent 4,248,762

United States Patent [19]

Hornibrook et al.

[11] **4,248,762**

[45] **Feb. 3, 1981**

[54] **PRESSURE SENSITIVE PRODUCTS WITH DECORATIVE APPEARANCE**

[75] Inventors: **Walter J. Hornibrook**, Newburgh; **Ronald A. Lombardi**, New Windsor, both of N.Y.

[73] Assignee: **Stauffer Chemical Company**, Westport, Conn.

[21] Appl. No.: **893,926**

[22] Filed: **Apr. 5, 1978**

Related U.S. Application Data

[62] Division of Ser. No. 816,236, Jul. 18, 1977.

[51] **Int. Cl.**[3] **C08K 3/08**

[52] **U.S. Cl.** **260/42.22**; 427/208.4; 428/328; 428/356

[58] **Field of Search** ..... 428/40, 328, 335, 336, 428/337, 906, 317, 355, 356, 323; 156/327, 332; 427/207 B, 208.4; 252/512, 511; 260/37, 42.52, 42.22, 37 M

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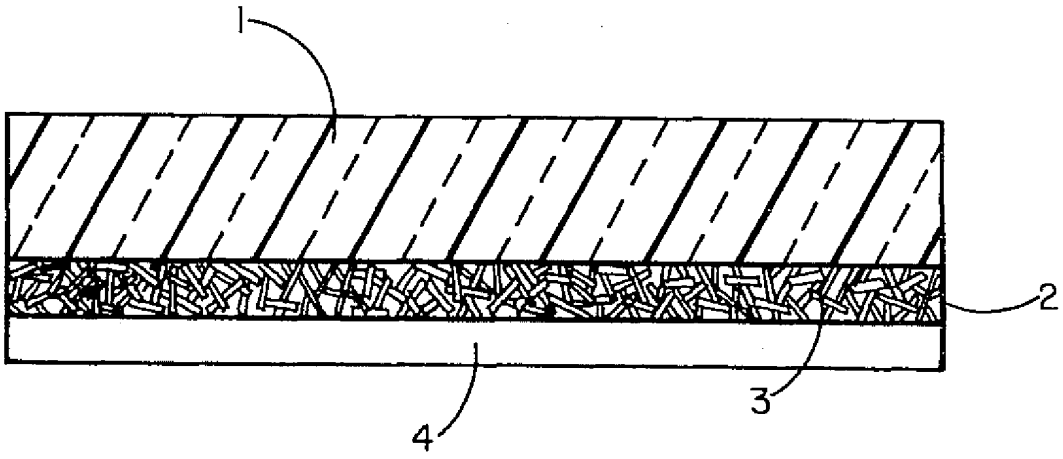
Primary Examiner—Stanley S. Silverman

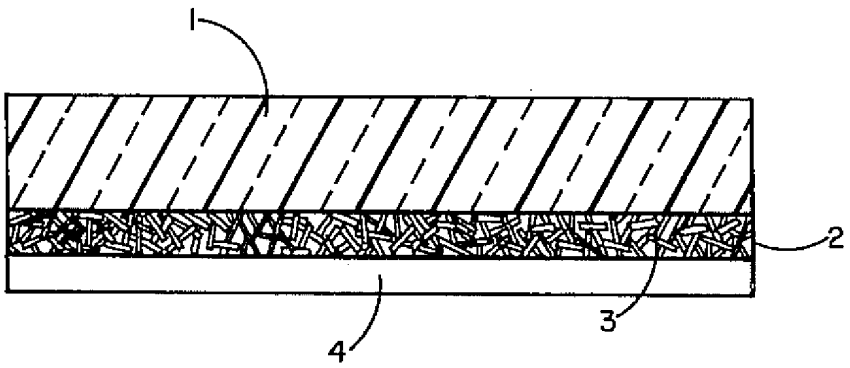
Attorney, Agent, or Firm—Richard P. Fennelly

[57] **ABSTRACT**

A pressure sensitive product with a decorative appearance is disclosed which comprises: (a) a substantially transparent plastic film; (b) a layer of pressure sensitive adhesive attached to the film, said layer containing non-leafing metallic flakes; and, (c) optionally, a release liner attached to the adhesive. Such a product is easily repositioned when first applied without substantial pressure to a desired substrate. After application of such pressure, the product exhibits superior adhesion as compared to a control product not containing the metallic flakes.

7 Claims, 1 Drawing Figure





FIGURE

PRESSURE SENSITIVE PRODUCTS WITH DECORATIVE APPEARANCE

This is a division of application Ser. No. 816,736 filed July 18, 1977.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is a pressure sensitive plastic film product with a decorative appearance which is useful, for example, as trim or a decorative marking on vehicles.

2. Description of the Prior Art

Pressure sensitive products with a decorative appearance, for example, a metallic or pigmented appearance, have been formed in the past using plastic films which are substantially transparent. In such products a thin coating which provides opacity and background color, sometimes referred to as a "blotch" coat, comprising ink and pigment has been juxtaposed between one side of the film and a pressure sensitive adhesive/release liner subcombination. In these known products, the blotch coat was quite thin, and the amount of pigment was quite critical if the desired properties were to be obtained. Inclusion of too little pigment resulted in a product not having the desired degree of opacity for the intended decorative effect. If too much pigment was present, the desired degree of opacity was achieved but the cohesive strength of the blotch coat was severely diminished leading to delamination of the pressure sensitive product.

SUMMARY OF THE PRESENT INVENTION

The present invention is a pressure sensitive product having a decorative appearance which comprises: (a) a substantially transparent plastic film; (b) a layer of pressure sensitive adhesive attached to the film, said layer containing non-leafing metallic flakes; and (c) optionally, a release liner attached to the adhesive. Such a pressure sensitive product is surprisingly, easily repositionable when first applied without substantial pressure to a desired substrate. However, after pressure is applied to affix it to the substrate in a desired position, it ultimately exhibits superior adhesion as compared to a control product not containing the metallic flakes.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE which is attached hereto and which forms a part of the specification is an enlarged cross-sectional view of a pressure sensitive product made in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The pressure sensitive product of the present invention will be more fully understood by referring to the Drawing which forms a portion of this application. In the Drawing, a preferred embodiment of the present invention is shown in cross-section wherein a substantially transparent plastic film 1 has laminated to one of its sides, a layer of pressure sensitive adhesive 2 containing non-leafing metallic flakes 3. A release liner 4 preferably covers the side of the adhesive layer 3 which is opposite film 1 in order to protect the adhesive from contamination from dirt or other solid or liquid contaminants.

The plastic film 1 may be any conventional, substantially transparent and flexible film known to persons of ordinary skill in the art of fabricating decorative pressure sensitive products. The term "substantially transparent" as used herein is intended to encompass those plastic films which are transparent enough to allow a viewer to perceive the decorative effect generated by the metallic flakes 3 in the adhesive 2. The film thickness will generally range from about 2 mils (0.05 mm.) to about 20 mils (0.5 mm.), and the film can be a homo- or copolymer of vinyl chloride, the preferred film material, a polyester resin, a cellulose resin, or the like. Films of this type are well known to the art and have been used heretofore in forming decorative laminates which differ in construction from the present laminate.

The pressure sensitive adhesive 2 which is used in the present laminate may also be any of the pressure sensitive adhesives which are known and conventionally used in the art. As for the applicable tacky, pressure sensitive adhesives which may be utilized in the product of this invention, they may be based upon an elastomeric material such as: (1) natural rubber; (2) synthetic rubbers including, for example, styrene-butadiene copolymers, polyisobutylene, butadiene-acrylonitrile copolymers, polychloroprene, and polyisoprene; (3) acrylic copolymers containing at least 50 percent, by weight, of a C_4-C_{12} alkyl acrylate ester, i.e., an alkyl acrylate ester wherein the alkyl group contains from 4 to 12 carbon atoms, together with a hardening comonomer, for example, vinyl acetate, styrene, methyl methacrylate, methyl acrylate, ethyl acrylate, ethyl methacrylate, and vinyl chloride; and (4) polymers of alkyl vinyl ethers such, for example, as polymethyl vinyl ether and polyethyl vinyl ether. Acrylic pressure sensitive adhesives are most preferred since they have the best balance of adhesive and cohesive properties for the present laminate. The thickness of the adhesive layer 2 will generally be in the range of from about 0.5 mil (0.013 mm.) to about 2.0 mils (0.05 mm.).

The pressure sensitive adhesive layer 2 contains an effective amount of non-leafing metallic flakes 3 to produce a desired decorative effect and to surprisingly increase the adhesion of the product after it has been applied with pressure to a desired substrate. These flakes 3 are homogeneously dispersed throughout the adhesive layer 2 by means of conventional mixing apparatus. The term "non-leafing metallic flakes" is well known in the art and such products can be formed by means well known to persons of ordinary skill in the art. For purposes of the present invention, non-leafing aluminum flakes are preferred, and the following description of its method of manufacture and properties will sufficiently apprise a person of ordinary skill in the art as to how this metallic component might be formed.

The aluminum flake which can be employed in the preparation of the laminate of the instant invention can be prepared in several ways. The most common means of obtaining aluminum flake is to atomize molten aluminum and subsequently grind it or hammer it in the presence of various lubricants. If the lubricant is a long chain saturated fatty acid, the prepared flake is not easily wetted by a resinous adhesive vehicle and tends to float to the surface subsequent to application, giving a more or less continuous layer of aluminum flakes. This phenomenon is called leafing. Such leafing flakes are not suitable for use in the laminate of the present invention. It is therefore desirable to remove the long chain fatty acid or to grind or hammer the atomized alumi-

num in the presence of other materials such as, for example, the short chain fatty acids. The flakes thus produced are more easily wetted by the resinous adhesive vehicle and tend to become randomly dispersed rather than to float and are therefore less likely to layer at the surface during the curing or drying of the adhesive.

The aluminum flake can, if desired, be subjected to various treatments which impart a gloss or polish thereto. These polished aluminum flakes may then be utilized when a highly reflective decorative effect is to be generated by the laminate of the present invention.

These non-leafing aluminum flake particles are plate-like in appearance but have a ragged edge which follows no geometrical design which may be observed as being peculiar to the flakes in general. The flatness or plate-like appearance of the flake is generally determined by the method by which the flakes were prepared. The hammered flakes tend to be more flat than the ball milled; however, both may be used with equally good results. For a more complete description of non-leafing aluminum flake and the methods of preparation, reference is made to Organic Coating Technology, Payne, vol. II, 1961.

The particle size of the flake should be predominantly from about 100 mesh to about 200 mesh. However, substantial amounts may be above 100 mesh and up to 60 mesh. A predominant number and preferably about 80 percent of the particles should be from about 200 to about 60 mesh. Excellent compositions may be made using flake having as much as 15 percent −325 mesh which aids suspension.

It is quite significant that at least the predominant amount of the aluminum flakes have a particle size in the range of from 200 to 60 mesh. As a substantial number of the particles approach a smaller size (−325 mesh) there are an insufficient number of larger planer surfaces provided in the adhesive to give the desired degree of opacity needed.

The aluminum flake particles are employed in amounts of at least about 5 percent by weight of the adhesive layer with a maximum of about 20 percent. Optimum effects have been obtained when amount of flake is present at about 12%, by weight of the adhesive. Use of too little flake will not give the desired decorative effects, whereas amounts higher than described above will weaken the adhesive/substrate bond. It is preferred that from about 10 percent to about 15 percent of the flake be used.

If desired, a tinting pigment may be added to the flake containing composition. Examples of such pigments which may preferably be used include phthalocyanine green, phthalocyanine blue, indanthrene yellow, burnt sienna, indo orange, phthalocyanine blue green tone, carbon black, phthalocyanine blue red shade, quinacridone red and hydrated iron oxide.

One suitable non-leafing aluminum flake product which is commercially available from Alcan Metal Powder, Inc. is known by the grade designation "Grade MD-3100".

If the laminate of the present invention is to be manufactured at one location and used at another location, a release liner 4 is preferably affixed to the side of the pressure sensitive layer 3 which is furthest removed from film 1. The release liner 4 may be any of the release liners known to persons of ordinary skill in the art of making pressure sensitive products including removable, water soluble protective coatings, and the like. One preferred liner material is silicone coated release paper having a thickness of from about 2.0 mils (0.05 mm.) to about 12 mils (0.3 mm.). Of course, if the film/adhesive composite is to be manufactured and applied to a desired substrate at the same manufacturing location, a release liner may not be needed.

The laminate of the present invention can be formed by any of the techniques used to form pressure sensitive films. In a preferred embodiment, when a release liner, such as release paper, is to be used, the adhesive formulation in solvent form containing the non-leafing metallic flakes is applied to the release liner and the adhesive/release liner composite is heated to dry the adhesive layer. This combination is then laminated to the plastic film to form the final product. In those few applications wherein the product is not intended to have a release liner, the adhesive/metallic flake composite can be cast onto the vinyl film, and the adhesive layer in the resulting laminate can be dried as needed.

The following Examples show certain preferred embodiments of the present invention:

EXAMPLE 1

This Example illustrates a procedure for forming a decorative pressure sensitive product in accordance with the present invention.

A transparent, plasticized polyvinyl chloride (PVC) film was heat laminated to itself on a lamination machine by passing two layers of such film over a series of hot drums in order to achieve a heat seal temperature of about 300° F. (149° C.). The PVC film was simultaneously embossed on one side with a brushed silk pattern at the lamination point. The film that resulted had a thickness of 8 mils (0.2 mm.).

An adhesive formulation was then prepared which comprised 100 gm. of a 30%, by weight, solids acrylic pressure sensitive adhesive polymer and 3 gm. of a non-leafing, finely divided aluminum flake. The adhesive that was used was a high molecular weight thermoplastic acrylic terpolymer available as "Durotak 80-1053" from National Starch and Chemical Corp. The aluminum flake that was used is commercially available from Alcan Metal Powder, Inc. as "Grade MD-3100".

The adhesive and aluminum flake were mixed together for from about 5 to about 10 min. at high speed to effectively disperse the aluminum flake particles. The adhesive/aluminum flake composition was then coated onto silicone coated release paper using a laboratory coating blade. Removal of the volatiles from this coated layer was accomplished by drying the layer for 2 minutes at 250° F. (121° C.) in an oven. The dried adhesive thickness was about 1.2 mils (0.03 mm.).

The resultant adhesive coated release paper was then laminated to the unembossed side of the transparent PVC film by passing both the film and release paper through a laboratory nip roller at sufficient pressure to insure intimate contact of the adhesive with the film. This PVC film/adhesive/release liner laminate was then conditioned for 16 hours at laboratory ambient conditions to allow the adhesive to form a strong bond to the film. The opacity and aesthetics of the laminate were judged to be satisfactory.

Peel adhesion of the product was then determined by bonding one inch (2.54 cm.) strips of the PVC/adhesive laminate (after removal of the release liner) to a stainless steel panel using the standard Pressure Sensitive Tape Council 4.5 pound (2.04 kg.) roller. Peel adhesion at 180° C. was then measured after a 24 hour wetout or

"dwell" period on a Thwing-Albert type tester. The value achieved was about 7.5 pounds per linear inch (ppli) or about 1.34 kg. per linear cm. Virtually all of the adhesive remained on the film thereby demonstrating both high adhesive strength to the film and high cohesive strength, the former being of more importance when the product is to be used as a permanent decorative film on a desired substrate.

A Control laminate, lacking the aluminum flake, yielded a peel adhesion of only 5.5 ppli (0.98 kg./linear cm.).

One advantage of the aluminum flake containing laminate as compared to the control laminate was the greater ease of repositionability that it exhibited. The presence of the flake reduced the "quick grab" of the adhesive allowing for initial repositioning of the laminate.

EXAMPLE 2

In another experiment, two other leafing, rather than non-leafing, aluminum flakes ("Grade MD-2100" and "Grade MD-5100" from Alcan Metal Powder, Inc.) were tried in similar amounts but they produced poor adhesion of the adhesive to the vinyl film when tested as above after 20 min. and 24 hr. dwell times on the substrate. The results of all tests are set forth in the Table which follows. All values are given as force (either lbs. or kg.) per linear (abbreviated "l.") unit of measure (either in. or cm.):

Stainless Steel Adhesion

No.	Metallic Flakes	20 min. Dwell	24 hr. Dwell
1.	None (control)	2 lbs. 6 oz./l. in. (0.43 kg./l. cm.)	4 lbs. 10 oz./l. in. (0.82 kg./l. cm.)
2.	Non-leafing[1]	3 lbs. 4 oz./l. in. (0.58 kg./l. cm.)	9 lbs./l. in. (1.61 kg./l. cm.)
3.	Leafing[2]	3 lbs. 4 oz./l. in. (0.58 kg./l. cm.)	4 lbs. 8 oz./l. in. (0.8 kg./l. cm.)
4.	Leafing[3]	4 lbs. 10 oz./l. in. (0.8 kg./l. cm.)	6 lbs./l. in. (1.07 kg./l. cm.)

[1]"Grade MD-3100" from Alcan Metal Powder, Inc.
[2]"Grade MD-2100" from Alcan Metal Powder, Inc.
[3]"Grade MD-5100" from Alcan Metal Powder, Inc.

Each of the above samples had the following peel adhesions after one minute: No. 1—3.5 lbs./l. in. (0.63 kg./l. cm.);

No. 2—1.3 lbs./l. in. (0.23 kg./l. cm.); No. 3—2.4 lbs./l. in. (0.43 kg./l. cm.); and No. 4—2.9 lbs./l. in. (0.52 kg./l. cm.). No. 2, the product of this invention, has the lowest initial tack but the highest adhesion after 24 hr. dwell times.

After 20 minutes, when the film/adhesive laminates were peeled back from the panel, product Nos. 1 and 2 showed no transfer of adhesive to the plate from the film whereas products Nos. 3 and 4 showed transfer of adhesive. After 24 hours, product No. 1 showed no transfer, product No. 2 showed cohesive failure of the adhesive as illustrated by adhesive remaining on both film and panel, and products Nos. 3 and 4 showed failure of the adhesive to the film as illustrated by most of the adhesive being left on the panel. In those end uses where the product is to be left permanently on the object, these observations are merely of interest as to how the internal strength of the adhesive (cohesive strength) and bond strength of adhesive to film and/or substrate (adhesive strength) are related. Adhesion strength would be unquestionably the most important property.

EXAMPLE 3

Approximately 2000 yards (1835 m.) of a 4 mil (0.01 mm.) transparent PVC film was heat laminated to itself and was simultaneously embossed on one side with a shallow brushed silk roll.

An adhesive formulation was prepared by mixing 300 gm. of the acrylic adhesive used in Example 1, 15 gm. of ethyl acetate, 15 gm. of toluene and 12 gm. of the non-leafing aluminum flake used in Example 1. The mixing was performed at high speed on a Cowles type dissolver until the flake was completely dispersed in the adhesive solution. The viscosity of the formulation after mixing was about 2000 cps. (Brookfield viscosity 25° C., No. 2 spindle 20 rpm.).

The adhesive formulation containing the aluminum flakes was then applied to 90 pound basis weight, bleached kraft, silicone coated release paper using a reverse roll coater. A streak-free, uniform coating of adhesive on the release paper was produced, and the adhesive coating was dried by passing the adhesive/-release paper laminate through an oven at 140° F. (60° C.) for 40 seconds followed by passage through a second oven at 270° F. (132° C.) for 45 seconds.

This adhesive/release paper laminate was then laminated to the unembossed side of the transparent PVC film as described in Example 1.

The resulting product was then tested against a control product that did not contain aluminum flakes in the adhesive using the test procedures described in Example 1. The adhesion at 180° was measured on stainless steel and lacquered panels using the same test method as described in Example 1. The results are given below in pounds per linear inch and (in parenthesis) in kilograms per linear centimeter:

Stainless Steel Adhesion

Film	20 min. Dwell		24 hr. Dwell	
Film of this Invention	4.2	(0.75)	10.3	(1.84)
Control	3.4	(0.61)	6.6	(1.18)

The 20 min. dwell readings showed no adhesive transfer from the film to the substrate, whereas both 24 hour dwell readings showed slight transfer using the same units given above:

Lacquer Painted Panel Adhesion

Film	30 min. Dwell		24 hr. dwell	
Film of this Invention	5.6	(1.0)	11.4	(2.04)
Control	5.6	(1.0)	6.5	(1.16)

At 30 minutes no adhesive transfer was noted for the film of this invention as compared to slight transfer for the control film. After 24 hours on the panels, both films showed cohesive failure as evidenced by transfer of substantial amounts of adhesive to the panel.

The films were also tested to determine the resistance by the adhesive to shrinkage of the vinyl film. This was evaluated by bonding a 1 inch × 10 inch (2.54 cm. × 25.4 cm.) adhesive coated film cut in the direction of travel of the film in the laminator to an aluminum panel with a standard 4.5 pound roller. The ends of the film were scored with a razor blade and after a 2 hour wet out period at room temperature the assembly was placed in

a 250° F. (121° C.) oven for 30 minutes. Growth of the razor cut was measured with a magnifier after the film was cooled to room temperature. The film of this invention had a mounted shrinkage of 1/64" (0.04 cm.), whereas the control film had a shrinkage of 2/64" (0.08 cm.)

EXAMPLE 4

This Example compares the adhesion of a film of the present invention (Film A) to that exhibited by the type of decorative film known to the prior art (Film B).

Film A was an 8 mil (0.2 mm.) transparent polyvinyl chloride film that had been prepared by laminating two 4 mil (0.1 mm.) films together followed by application of adhesive containing non-leafing aluminum flakes as described in Example 1.

Film B was a 7 mil (0.175 mm.) transparent polyvinyl chloride film made by laminating a 3 mil (0.075 mm.) transparent film to the vinyl side of a 4 mil (0.100 mm.) film that had previously been printed on one side with a silver ink for decorative purposes. The same adhesive used in making Film A was applied to the silver ink side of the 7 mil film without the presence of the aluminum flakes.

Both films were applied to lacquer painted stainless steel panels and the peel adhesion was measured after the two films had been subjected to various environmental conditions for various lengths of time. The procedure described in Example 1 was employed to mount the films and measure the peel adhesion. The Table that is given below sets forth the results that were obtained in pounds/linear inch and (in parenthesis) kg./linear centimeter:

Condition	Time	Adhesion of Film A	Adhesion of Film B
Room Temperature	72 hrs.	10.5 (1.88)	5.5 (0.98)
158° F. (70° C.)	7 days	10.3 (1.84)	6.5 (1.16)
158° F. (70° C.)	14 days	9.5 (1.70)	6.5 (1.16)
158° F. (70° C.)	30 days	9.3	5.3
		(1.66)	(0.95)
100° F. (37.8° C.) 100% Relative Humidity	7 days	10.5 (1.88)	6.8 (1.21)

These data demonstrate the uniformly higher adhesion values for the film of the present invention as compared to the type of film known to the prior art.

The above Examples merely illustrate certain preferred embodiments of the present invention and should not be construed in a limiting sense. The scope of protection which is sought is set forth in the appended claims.

What is claimed:

1. In combination, a pressure sensitive adhesive with non-leafing metallic flakes having a predominant particle size of from 200 to 60 mesh homogeneously dispersed throughout said adhesive in an amount of from at least about 5% to about a maximum of about 20%, by weight of adhesive, to render a plastic film laminate containing a layer of said adhesive initially repositionable when applied to a substrate and to confer increased adhesion for said laminate after sufficient pressure is applied to the laminate to bond it to the substrate.

2. The combination of claim 1 wherein the metallic flakes are aluminum flakes.

3. The combination of claim 2 wherein the metallic flakes are present at from about 10 weight percent to about 15 weight percent of the adhesive.

4. The combination of claim 1 wherein the pressure sensitive adhesive is an acrylic pressure sensitive adhesive.

5. The combination of claim 1 wherein the metallic flakes are present at from about 10 weight percent to about 15 weight percent of the adhesive.

6. The combination of claim 1 wherein the adhesive is an acrylic pressure sensitive adhesive and the metallic flakes are aluminum.

7. The combination of claim 6 wherein the metallic flakes are present at from about 10 weight percent to about 15 weight percent of the adhesive.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,248,762

DATED : February 3, 1981

INVENTOR(S) : Walter J. Hornibrook et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, line 21, "an" after "upon" should read -- any --.

Signed and Sealed this

Twenty-fifth Day of *August 1981*

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer *Commissioner of Patents and Trademarks*